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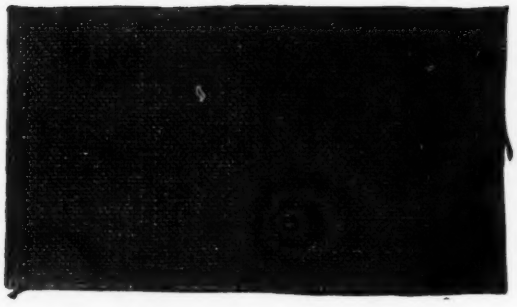

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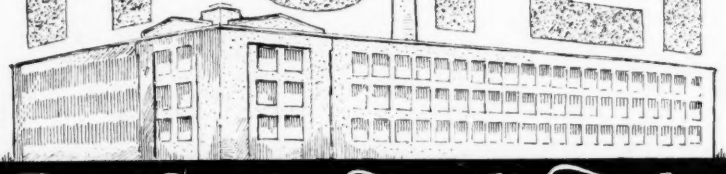

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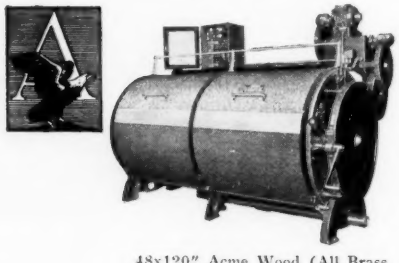

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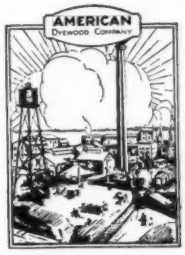

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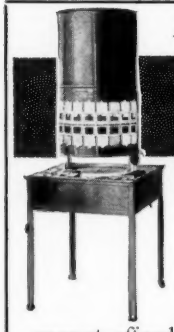

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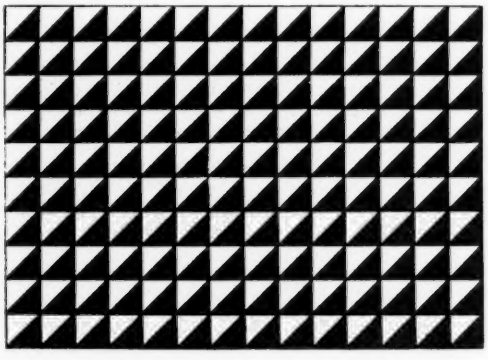

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VOLUME XII NEW YORK, SEPTEMBER 24, 1923 NUMBER 20

Stains Arising in a Finishing Plant

A Summary of the More Common Causes of Stains, with Practical Suggestions for Their Obviation or Removal

By E. W. ADAMS

THE statement that "he who does nothing never makes a mistake" holds very true in a textile plant. When a plant is running at full capacity, stains and troubles multiply. This may be explained as due in part to the following: (a) A general speeding up with a less careful watch all along the line, (b) the hiring of new men and breaking them in, and (c) a tendency to rush the work along.

In this paper we shall discuss some of the stains and troubles arising under the following main headings:

I. Stains from faulty processing in the gray mill or through faulty handling while in transit.

II. Stains arising through faulty processing in the finishing plant.

III. Stains developing after leaving the finishing plant.

I.—Stains from Gray Mill or in Transit

Gray mill stains and troubles may usually be classed under the following: (a) faulty weaving, (b) oil stains, (c) soap left in the gray goods after spot washing, (d) tenderness due to the use of "salts of lemon" or oxalic acid to remove iron stains, and (e) tenderness due to the use of magnesium chloride or zinc chloride in the warp sizing.

During the past four years we have received goods stained in transit by (a) tar, (b) mineral acid, (c) wood extract, and (d) mildew and rust stains from straps on the bale.

The burlap wrapping on the bale usually protects the gray goods. If the tar is fresh, the major portion may be removed by first scraping and then treating with an organic solvent such as lard oil, benzene, etc. Since mineral acid tenders the goods, shears or a knife are the best remedy followed by a good washing.

During the past summer we received a bale of duck which had become badly stained by wood extract. We first washed thoroughly in hot water and then sent the goods through our regular bleaching process. Not a trace of the stains could be found in the finished duck.

Occasionally a bale of gray goods is wet in transit. If badly soaked with water, mildew makes its appearance. If the stains are light, they may be removed by bleaching and souring; if possible use oxalic acid for final sour since oxalic acid is one of the best removers of rust stains. If impossible or inconvenient to use oxalic acid, add some hydrochloric acid to the regular sulphuric acid sours. (We assume that sulphuric acid is used for souring.)

Faulty weaving has no part in this discussion. Mill oil usually occurs as yellow spots or blotches, a single oily thread or several oily warps together. The finisher is not responsible for gray mill oil, hence no special attempt is made to remove gray mill lubricating oil. Goods are stained in the gray mill with oil from dripping bearings, by careless oiling of machinery, or by the handling of warps by workers with oily hands. When goods have been bleached and are to be subsequently dyed, the dyehouse second hands or workmen string stained bleached goods by tying or knotting a soft yarn along the selvage of the cloth containing the oil stains. This relieves the dyehouse of responsibility for those stains.

Mr. J. H. Schaller of the Cluett Peabody Company in a recent address at Atlantic City before the National Association of Cotton Manufacturers gave some very interesting experiences with oil stains. His experience was that if fresh oil stains were washed out within twenty-four hours after their occurrence, no stains were visible at the end of three months. If oil stains were washed within ten days of their occurrence, while they might look all right after washing, at the end of three months the stains would be present. If the goods were washed within twenty days, at the end of three months the oil stains would be present. Mr. Schaller also stated that special washing compounds or oil removers gave similar results to those mentioned above. If the oil stains are not removed when fresh, Mr. Schaller feels that the only remedy is the use of the scissors.

The use of dyestuffs in lubricating oils has been suggested. During the past year some very interesting work has been done in this field. It is not sufficient to

dye the oil that the source may be known, the oil and dyestuff must be removable.

Gray mills frequently spot wash soiled pieces. For white work, this spot washing causes no injury. However, if the goods are to be dyed with sulphur colors, trouble will occur. Soap left in the goods may resist the dye, or the fiber may be bruised during the spot washing, then, the bruised fiber will subsequently dye differently. Some dyehouses refuse to have anything to do with such goods. Spot washing done in the gray mill can usually be identified by the hungry, washed-out patches in the goods.

Occasionally the man in charge of singeing reports that goods going over the gas flame or over the plate singer are tendering. If the tenderness occurs in spots or patches only, test the tender places qualitatively for oxalic acid. Both oxalic acid and potassisum binoxalate (salts of lemon) are sometimes used to remove iron stains by operatives in the gray mill. The use of these may, or may not, be with the sanction of the mill officials. If the tenderness occurs regularly and across the warps, test qualitatively for magnesium chloride or zinc chloride. Most mills have been educated about the disadvantages of these agents. Now and then a mill buys prepared sizing preparations, the ingredients of which are deep secrets which cannot be revealed by the salesman. If you find that certain mills continue to send such goods, their attention should be called to the tender goods, and they should be warned as to the use of spot washes or chlorides of zinc and magnesium used in the size. If magnesium or zinc chlorides are present in the gray goods to be singed, thoroughly wash and redry before singeing to remove these harmful chlorides.

II.—Stains Arising During Processing

The most common troubles arising in the bleachhouse are: lime burns from improperly slaked lime, air stains caused by allowing goods while hot and containing bowking liquors to come in contact with air (these are usually yellow brown and irregular in shape), iron stains (caused by either the cotton goods rubbing against rusted iron or by wash waters carrying iron), drips of dirty water and oil, tenderness caused by acid spatters and also by oxycellulose, resists usually caused by the deposit of insoluble lime salts, rub marks and herringbones caused by the tension with which the goods in the rope are drawn through pot eyes and over reels, wood stains, and bleeding.

Iron stains are easily identified by first dipping the cloth in dilute hydrochloric acid and then into a weak solution of potassium ferrocyanide. If iron is present, the stain becomes a bright deep blue, a Prussian blue being formed. Iron stains thus formed are usually removed by chemicking, and then souring with a mixture of muriatic and sulphuric acid.

Dirty water drips are usually easily removed by washing. Oil drips, if not too bad, may be removed by spot washing with soap or a mixture of soluble oil carrying kerosene, carbon tetrachloride, or similar solvents.

Occasionally goods passing through the sours pit are spattered with strong acid with consequent tendering. However, such tenderness is and should be a rarity. With the use of too strong or too warm chemic, oxycellulose may be formed. Oxycellulose reduces Fehling's solution and is dyed by methylene blue without mordanting; other tests are given in a Summary of "Oxycellulose" by Percy Herbert Clifford and Robert George Fargher for the British Cotton Industry Research Association.

Resists make their appearance when bleached goods are to be dyed or printed. These resists are usually caused by insoluble calcium salts. When goods are suspected of containing such salts, ash approximately ten grams. This ash should be fused with a mixture of potassium nitrate and sodium carbonate. When the fusion product is cold, dissolve in hydrochloric acid, filter, and evaporate down to about 10 c.c. Test qualitatively for calcium.

Goods to be dyed into heavy shades with sulphur or wood colors should never be bleached in the rope unless a harvest of rub marks and herringbones are desired. Should any such goods rub on a brass pot eye or come in contact with copper, when dyed, dark streaks will call attention to that fact in no uncertain tones.

Occasionally when bleached goods are piled in old wooden bins, grayish black blotches are caused by the tannins of the wood. Decayed wood will also give yellow brown stains. These stains may be removed by chemicking and souring.

Goods containing colored headings or borders should never be given a pressure boil. During the boil such coloring matter is reduced (if it is a vat color) and stains or runs into the white. There have been various patents taken out abroad and in this country relative to this boiling but all are "without guarantee." Goods containing such borders or headings should be bleached in slack washers (Rodney Hunt machines are a standard type), or in open kiers with all possible precautions taken. Before going ahead with any lot containing colored yarns identify the dyestuff with which it is dyed and further bleach a small sample on as nearly a practical scale as is possible. Sometimes some of these headings or borders, especially several of the Indathrene Blues, may become overbleached by chlorine. The original color may be restored by running through a weak solution of hydrosulphite.

If through a mistake colored borders are boiled under pressure with white work, the white will be badly stained. In one instance called to my attention, a toweling with edge warps dyed with indigoid dyestuffs was given a pressure boil. The mark-offs from the dyed warps looked like a bad claim. However, by an extra boil in an ash kier the goods were bleached a perfect white. In a case of this kind one or two bales at a time may be cleared by mixing in with a regular kier of goods to be boiled with soda ash.

A frequent stain in dyehouses is from undissolved dyestuff. All dyes should be stored and issued from a central drug room or storeroom. These dyes should be dissolved and properly strained before being given out. Sometimes through poor straining or lack of any straining the dye specks show up on dyed work. Basics require special care and give the most trouble. No colors are foolproof. Workers on machines, pads, or jigs should keep strictly away from the drug room—and also drug room help have no business hanging around goods in process since their clothes may carry much finely powdered dyestuff. Cheese cloth folded double makes an excellent straining cloth. Discard old dirty cloths and do not let them dry out. Direct colors dissolve well in hot or boiling water whereas many of the basic colors give a tarry or gummy precipitate when treated with too hot water.

A neighboring mill dyeing chambrays recently was in trouble due to the use of unstrained basic red topping used on a chlorine fast yellow dyed warp yarn. The red had not been strained, hence the red specks over the yarn. The filling was bleached yarn. In order not to spoil the chambray, I suggested chemicking. Chemic killed the red specks and did not harm the chambray effect.

Frequently streaks and striped effects on dyed work are called to the attention of the management. Three common ones are caused by (a) jets of steam from a perforated steam pipe striking the goods while in process, (b) strong jets of wash water striking the goods, and (c) spray pipe on dyeing pad not delivering enough dye liquor to keep the dye box full—or by the goods absorbing the dye liquor faster than it is being fed into the dye box. Of these three (b) strong jets of wash water is the only one to need any discussion since (a) the steam jets may be so arranged that the live steam will not strike the cloth, and in the third case (c) more liquor may be fed by means of an auxiliary pipe. Streaks caused by jets of wash water striking the cloth may be overcome by using concentric pipes—a small spray pipe within a larger slotted pipe. The spray strikes the back of the slotted pipe and a single sheet of wash water is delivered onto the goods through the slot in the larger pipe.

Some sulphur colors particularly sulphur blues, give trouble by bronzing on the selvages, especially when dyed on jigs. Pick your sulphur colors carefully and, if possible, dye on a continuous machine.

Sulphur colors are among the most exacting that a piece goods dyer handles. If wet cotton goods dry out on trucks, get heavy wrinkles, are diastafored or bleached unevenly, the cotton fiber bruised or rubbed against copper before dyeing, a host of laymarks, blotches, and streaks call attention to the lack of proper care. After dyeing sulphur colors, it is equally essential that all sulphide be washed out; if not properly washed the goods develop stains due to the uneven oxidation of the dyestuff. This is particularly true if such goods lie on a truck long before washing.

Water drips are another source of trouble to the dyer of aniline blacks, vat colors, sulphur and mineral khaki. However, they may be easily traced and the cause removed.

Aniline blacks are usually dyed from the gray without bleaching but may be preceded by diastaforing or mercerizing. If the goods are not thoroughly washed after either of these operations, resists show up, usually along the selvages. Resists from improper washing after diastaforing show up generally as a brownish green, feel thick and gummy, and reduce Fehling's solution as would be expected from the action of diastafor in converting the starch in the size to sugar. Caustic resists are white. Removal of the resists and another run through a weak dye liquor will cover such stains.

In another plant some years ago, Egyptian shades dyed with sulphur colors had an epidemic of brownish black spots. The dyer diagnosed them as chars, the superintendent as dye specks. The microscope showed them to be tiny metallic scales from the inside of the feed pipe.

In waterproofing colored goods with an aluminum soap, white streaks sometimes show up where the aluminum acetate has dried out on the folds or along the selvages. Goods should be run through the aluminum acetate solution only as fast as the driers can take care of them or the trucks should be well wrapped with cloths wrung out in water. If the white streaks cannot be removed by water alone, run them first through weak muriatic acid and then wash the goods. This remedy effectively removes the white streaks.

In the starch rooms the most trouble is caused from dirty boxes or dirty machinery—all of which is avoidable.

Very little trouble arises from can drying. Running light shades after drying shades that crock, and can burning are the most frequent complaints.

Dirty or oily clips on the stenter frames, and also dirt from the hot air fans, cause some trouble.

Practically no stains come from the calender rooms if the machinery is kept clean and proper attention is paid to the expanders on the calenders. If Mycock expanders are not given proper care, fine specks of graphite work into the goods. A run through weak diastafor solution will remove the graphite as if by magic.

III.—After Finishing

After finished goods leave the plant, most of the trouble arising is through improper storing.

The finish on a case of goods may be utterly ruined and mildew will develop if the goods are shipped in a leaky railroad car or are stored in a damp warehouse.

Shipment in a steamship hold with aniline black dyed goods or with rubber merchandise will and has given many a case of "pinking." Mr. Hobbs, director of the Sears, Roebuck laboratories, recently published in this magazine an article dealing with the pinking of bleached goods when stored with rubber tires. Manchester (England) finishers have gone on record that they will not be

responsible for the pinking of their product when stored with aniline dyed goods.

In recent years the canvas shoe trade has had considerable difficulty because of the pinking of shoes. No fault is found with the bleached duck until after manufactured into shoes. The cause of this pinking in practically every case can be traced to the use of composition rubber heels and soles. The vulcanization of these heels and soles has been hastened by the use of such organic accelerators as aniline, formanilide, etc.

These are a few of the troubles taken from my loose leaf notebook which may come to the attention of any textile chemist. I find that a record of the trouble or stain with sample attached frequently comes in handy and I believe that any plant maintaining a laboratory should keep some file of its troubles. The personnel of a laboratory changes but the work goes on regardless of such changes. Old records may save a new man much needless work.

Much interesting information can be obtained from the "questions and answers" columns of the several textile papers. The following books contain much valuable information:

The "Kink Books" published by the Textile World Journal and edited by C. Hutton.

"Sizing and Mildew," by Dreyfus and Davis—an English book now out of print but which may be obtained with some difficulty through second-hand book dealers.

"The Chemistry and Practice of Finishing," Bean and McCleary.

"The Principles of Bleaching and Finishing of Cotton," Trotman and Thorp.

Bleaching by Means of Sodium Hypochlorite*

Theory of Bleaching Action of Hypochlorous Acid—Methods of Producing Sodium Hypochlorite—Liquid Chlorine Preferable to Bleaching Powder—Solid Sodium Hypochlorite a Possibility for the Future

By W. M. INMAN, M.Sc., A.I.C.

THERE has been much discussion about the mechanism of the bleaching action of hypochlorous acid and the various hypochlorites. The original idea that these compounds bleached because they contained loosely combined chlorine which could detach itself from the remainder of the compound gave rise to the term "available chlorine," and it is perhaps unfortunate that the "percentage of available chlorine" is still used to denote the bleaching value of a hypochlorite. The belief that it is active chlorine which performs the bleaching is still held by some.

R. L. Taylor found that on blowing air free from carbon dioxide through hypochlorite solutions, free hypoclorous acid was expelled. Thus any hypochlorite in solution must be hydrolyzed to a certain extent into hypochlorous acid and free base. It is generally accepted that it is this free hypochlorous acid which is responsible for the bleaching powers of a hypochlorite solution, but there is much debate as to how it reacts. Taylor holds the view that when hypochlorite solutions are exposed to air the carbon dioxide acts upon any chlorides present producing small quantities of carbonates and hydrochloric acid, which latter then reacts with the hypochlorous acid to form water and nascent chlorine. But the more usual theory of the bleaching action of hypochlorous acid is that it simply breaks down into hydrochloric acid and nascent oxygen. Alkaline hypochlorites may behave in a similar manner, or it may be possible that their bleaching powers are due entirely to the free hypochlorous acid present, and that when this is destroyed in bleaching the hypochlorites simply produce more. This second possibility would account for the view expressed by Heermann, viz., that all hypochlorites have the same bleaching efficiency, no matter what the base.

His experiments were performed for convenience with calcium hypochlorite, but he holds that they are equally applicable to any hypochlorite (see J. Soc. D. & C., 1922, p. 282).

The results of the researches mentioned confirm facts which have been well known to bleachers for many years.

Chemists who have studied the problem hold the view that sodium hypochlorite is in no way superior to calcium hypochlorite as a bleaching agent, while bleachers who have tried both say that it is superior. Again, both experimental and works chemists generally hold the view that the bleaching power of any hypochlorite solution is determined entirely by the amount of available chlorine it contains. But the discussions have been considerably complicated by the introduction of the term "an active bleaching agent." Presumably an active agent is one which will bleach quickly, and where time is of more value than bleaching liquor, a large quantity of a hypochlorite which will produce an effect rapidly is more economical than a smaller quantity of a liquor which will take a longer time; but if two solutions of different concentration are used in volumes containing the same amounts

*A paper read before the Midlands section of the Society of Dyers & Colourists, and published in the Journal of the Society.

of available chlorine on similar quantities of material they will ultimately destroy equal amounts of coloring matter. They will not do this in the same time, nor possibly will the degree of whiteness of the material be the same.

The speed of bleaching, or the "activity" of the bleaching liquor, depends largely on its alkalinity. Freshly prepared bleach liquor made from bleaching powder is by no means as active as old liquor which has been neutralized by atmospheric carbon dioxide or by carbon dioxide derived from the materials bleached. Strongly alkaline sodium hypochlorite does not bleach as quickly as neutral sodium hypochlorite. Magnesium hypochlorite made by treating calcium hypochlorite with magnesium sulphate is a very rapid bleaching agent. When so prepared it is neutral, and therefore extremely active; in fact it is so active that it is very difficult to control. Ease of control is perhaps the most desirable feature of sodium hypochlorite as a bleaching agent. Its alkalinity can easily be regulated, and so its bleaching action can be developed rapidly or slowly as desired. Sodium hypochlorite is more stable than calcium hypochlorite, and is less affected by carbon dioxide.

All sodium salts are readily soluble, and therefore no matter what compounds are produced in the material when the coloring matters are broken down by sodium hypochlorite, they can easily be washed out, and the souring operation is frequently omitted.

It has been said that any insoluble particles, such as dirt or calcium carbonate, act as catalysts, and cause overbleaching, and so tender the fabric. When sodium hypochlorite is used this danger of local overbleaching is considerably lessened, since both the bleaching agent itself and any compounds it produces during its bleaching action are readily soluble. The fact that sodium hypochlorite is so very soluble is generally believed to insure a more thorough penetration of the fabric, and this, together with the fact that its action develops regularly and evenly, gives it a distinct advantage for fine goods. There has also been much discussion on the point whether sodium and calcium hypochlorites produce equally good whites. It is difficult to debate the matter on purely theoretical grounds. A certain concentration of available chlorine will always have the same oxidizing power, and will therefore always destroy the same quantity of coloring matter, but there may be possible differences in the compounds produced by the destruction of the coloring matters by the hypochlorites. In the case of sodium hypochlorite, any compounds of the base and the coloring matters or their degradation products will necessarily be soluble and easily removed. Calcium compounds, on the other hand, are frequently very insoluble. Efficient souring will remove a large percentage if not all of the calcium compounds, but really efficient souring is difficult. The compounds which it is desired to remove have been formed to a certain extent in the fiber, and to remove them the acid must reach them and dissolve them, and finally the soluble products must find their way out of the fiber again; and it is probable that in most cases where calcium hypochlorite is used in bleaching there are small quantities of calcium compounds left in the fibers. In certain classes of goods where harshness is desired, this effect is obtained deliberately, and calcium hypochlorite is then preferred as a bleaching agent. I have no first-hand knowledge of a comparison of the whites produced on textiles by calcium hypochlorite and sodium hypochlorite, but in the case of paper pulp there is a marked difference in the effect produced by equivalent quantities of the two hypochlorites. In a particular experiment the calcium hypochlorite gave a good color, and the pulp was being used for the manufacture of a high class paper, but the pulp bleached by sodium hypochlorite was much better. The color was a blue-white rather than a yellow-white, and the fibers were much more translucent. When two batches were seen in bulk side by side the difference was very marked. The calcium hypochlorite bleached pulp appeared distinctly cream colored when compared with the white produced by sodium hypochlorite. Paper pulp is, of course, not soured, but is washed very thoroughly. Possibly such a marked difference would not be obtained in the case of cloth which could be soured.

Sodium hypochlorite can be prepared by precipitating bleach liquor with sodium carbonate, sulphate, or hydrate, allowing to settle and decanting off the clear solution. A second method is by the electrolysis of common salt solutions. This process has never found much favor in this country among bleachers, chiefly because if it is to be economical an electrolytic plant must be very large. The difficulties of working a plant are exactly the same whether it is small or large, and the cost of technical supervision is also practically the same. A third method of producing sodium hypochlorite is by the absorption of chlorine in caustic soda solutions. This is the usual convenient laboratory method of preparing sodium hypochlorite, and it works equally well on a large scale. It is essential that the temperature should be kept low, or otherwise sodium chlorate will be the chief product of the reaction. Liquefied chlorine is now an article of commerce, and is easily handled and transported. For many years before the war it had been used extensively in Germany, but in this country it was practically unknown, chiefly because the railway companies regarded it as a dangerous chemical, and would not carry it. The demand for liquid chlorine for military purposes altered this state of affairs, and to-day it is the most convenient source of chlorine for the general consumer. It is packed in steel cylinders or tank wagons, and is rapidly coming into use in the manufacture of bleaching liquors at the place at which they are to be used.

This is a reversion to the practice of a hundred years ago, when bleach liquor was made from chlorine gas and milk of lime at the various bleach works. To prepare sodium hypochlorite the plant necessary is an absorption vessel fitted with an agitator, or a tower. If the solution desired is not too strong there will be no need to provide any special cooling device. If a tower is used as the absorption apparatus it will be necessary

to restrict the plant to the production of a liquor of medium strength. If very concentrated caustic soda solutions were chlorinated, a point would soon be reached at which the liquor was saturated with respect to common salt, crystals would then be deposited, and the tower would shortly cease to operate. As a general rule this point is never reached. The determining factor is the rise of temperature due to the heat of reaction of the caustic soda and chlorine, and the liquors are kept dilute to avoid an excessive rise in temperature; 25 deg. Cent. is regarded as a very safe limit.

The greatest strength of hypochlorite solution which can conveniently be made is approximately 15 per cent, or 150 grms. per liter, of available chlorine. In some cases where storage space is limited the compactness of the bleach plant and the small storage space required for liquid chlorine and solid caustic soda is a distinct advantage. Bleaching powder is bulky, and the usual bleach mixing plant is large. Sodium hypochlorite solution made in this manner can be varied to suit any bleaching requirements. If a very alkaline, and therefore slow bleaching, liquor is desired, the process is stopped when the free alkali has been reduced to the desired concentration. Such a solution will bleach slowly, but if allowed the necessary time, is believed to produce the best possible and most durable white. When it is essential that the time of bleaching should be short, the solution of caustic soda can be chlorinated further; in fact, almost to the point at which there is no more free alkali. It is not advisable to push this reaction too far, since if an acid solution is obtained, the liquor will decompose rapidly with evolution of oxygen, and the net result of the process will be the conversion of expensive caustic soda into useless common salt. It is better to chlorinate until the residual alkalinity is about 0.2 per cent. If an exactly neutral sodium hypochlorite is required, this liquor, containing 2 grms. per liter of caustic soda, can be treated with magnesium chloride solution. Magnesium hydrate will be precipitated, and its equivalent of sodium chloride will go into solution.

Such a neutral solution will bleach very rapidly, and may in some cases get quite out of control owing to the production of acid compounds during the oxidation of the organic coloring matters. For normal purposes a slightly alkaline solution gives the best results. For very fine goods, where overbleaching would be fatal, and underbleaching a serious fault, prolonged treatment with a dilute solution containing more free alkali is advisable. The high solubility and diffusibility of sodium hypochlorite insure a thorough penetration of the material, and the alkalinity of the liquor will prevent even a local excessive reaction. Stronger solutions of sodium hypochlorite than of calcium hypochlorite can be used without fear of tendering due to rapid local actions on the fiber.

As has already been mentioned, when calcium hypochlorite is used, any evolution of carbon dioxide from the coloring matter of the fibers will react on the liquor, and produce calcium carbonate and hypochlorous acid; the calcium carbonate being deposited on the fiber, and the unstable hypochlorous acid then reacting vigorously, over-bleaching may result. With a somewhat alkaline solution of sodium hypochlorite the first of these two dangers is entirely eliminated, and the second is minimized.

"Eau de la Barraque," or, as it is usually termed, "eau de Javelle," may be made by passing chlorine into a solution of sodium carbonate until effervescence commences. The reaction results in the production of sodium chloride, sodium hypochlorite, and carbon dioxide. The carbon dioxide is absorbed by the unchanged carbonate to form bicarbonate until the point is reached at which the carbonate is exhausted. If the reaction is stopped just before this point is reached the solution obtained is stable, and can be used conveniently for bleaching purposes. It is, of course, an expensive method of bleaching, since a large quantity of carbonate is required to stabilize a relatively small proportion of available chlorine. If the reaction between chlorine and sodium carbonate is carried further, the bicarbonate will also be acted upon by chlorine and will produce sodium chloride and hypochlorous acid, and carbon dioxide will be evolved. Such a solution is practically useless as a bleach liquor, since the hypochlorous acid is too unstable.

There is, however, a possibility that sodium carbonate and chlorine may be used for bleaching purposes by causing the reactions described to take place on the material itself. Careful control would be necessary, or overbleaching might result. Hypochlorous acid is a remarkably rapid bleaching agent, but demands intelligent use. The material could be soaked in a solution of sodium carbonate of suitable strength and then exposed to the action of chlorine gas into a closed chamber into which the chlorine was admitted at the speed desired. The rate at which the chlorine was admitted would determine the rate of bleaching, and thus it would be a simple matter to control the whole reaction. It would perhaps not be difficult to make the process a continuous one. This method of bleaching by producing hypochlorous acid on the material itself has been tried on paper pulp, but the experiment was not a complete success, for though the bulk of the material was well bleached, the "knots," that is, tangled masses of pulp about 40 to 50 square inches in area and two or three inches thick, which are always produced in the particular type of plant used for the experiment, were not completely penetrated by the gas, and had unbleached portions in the center.

Such a difficulty as this would not arise in the case of cotton or linen cloth or piece goods which could be exposed to the action of the chlorine in single thicknesses, without any difficulty. I am not aware of any such trial having been made, but the bleaching effect would undoubtedly be as good as that obtained by means of sodium hypochlorite in the ordinary way, and the treatment with chlorine gas could be carried to such a point that any

souring treatment would be quite necessary, and washing with water would quickly remove all the products of bleaching.

It is possible that after lye boiling and the subsequent washing, cloth still contains a small quantity of alkali which would be usefully applied if such a system of bleaching could be worked successfully. In the United States and in Canada there is a growing tendency to produce large quantities of bleach liquor from milk of lime and liquid chlorine, and paper mills in particular are turning to this system in preference to electrolytic processes. The large North American mills, which use considerable quantities of "bleach," buy their liquid chlorine in tank wagons. The wagons are connected by pipes to evaporators, and the quantity of gaseous chlorine supplied to the absorbers is regulated simply by the flow of liquid from the tank to the small evaporator. The gas from the evaporators is introduced at the bottom of an absorption tower down which milk of lime is flowing. The mixture of milk of lime and bleach liquor is pumped from the bottom of the tower back to the top. This circulation of the liquor is continued until it reaches the desired strength. It is then run to a settling tank, and after the small quantity of sludge has settled, the clear bleach liquor is run to a stock tank. The sludge can then be reinforced by more milk of lime, and the process repeated until the accumulation of sludge becomes objectionable.

Tests of the efficiency of such a plant have given very good results. In one such test in which the entire contents of a tank wagon were consumed, the efficiency of absorption was found to be practically 100 per cent. Of the total chlorine absorbed, 99.17 per cent appeared in the bleaching liquor as available chlorine. Thus chlorate formation had been negligible. The loss of available chlorine in the sludge was 0.31 per cent; 1.052 pounds of quicklime were used per pound of chlorine absorbed. The test showed the whole plant to be very efficient and economical, and to possess decided advantages over the usual method of bleach-liquor production from bleaching powder.

In Great Britain liquid chlorine has not as yet effected any such sweeping changes. It is possible that in the near future bleaching powder mixers may be replaced by absorption apparatus, but it is more probable that the reaction will be carried out in the usual type of bleach mixer. This is quite easily possible. All that is required is a fairly deep mixer and rapid agitation. It is desirable, though not essential, to have a cover over the mixer. With a covered mixer any small quantities of chlorine which escape through the liquor are absorbed on the surface before they can escape.

A trial run of this bleach-making method has been carried out, and showed an efficiency of 97.4 per cent. The conditions were severe. The tank used was deep, about 6 feet 6 inches, but that was the only favorable factor in the experiment. The lime was poor; it contained only 85.6 per cent of calcium oxide and as much as 1 per cent of iron. The agitation was poor, and the mixer had no cover. Nevertheless, the efficiency compares favorably with the usual efficiency of extraction of available chlorine from bleaching powder.

There is still another method of employing liquid chlorine to advantage, and this will probably find most favor with British bleachers. It consists simply in chlorinating the free lime present in all bleaching powders during the agitation of the powder with water to make bleach liquor. This may be done in the usual type of bleach mixer. One or two dip pipes leading down to the bottom of the mixer are required, to which the chlorine cylinders can be connected. If the rotation of the mixer is very rapid, having a peripheral speed of 500 feet per minute or thereabouts, the chlorine can be introduced as liquid, and allowed to vaporize in the tank. This allows the cylinder to be emptied rapidly and given suitable agitation and a deep mixer it is possible to introduce the necessary quantity of chlorine in 20 to 25 minutes.

It has been found by experiment that average bleaching powder can absorb about one-ninth of its own weight of additional chlorine. This means that one 70-pound cylinder of chlorine can conveniently be used with each 6-cwt. cask of bleaching powder. Stronger liquors can, if necessary, be made in the same plant, and the output of any given plant can therefore be materially increased without any other alteration than the provision of chlorine inlet pipes. The quantity of sludge is considerably reduced, sometimes to as little as one-quarter of its former bulk, and instead of sludging out after each mixing, two or even three batches can be mixed in succession before the sludge need be washed and removed.

Much work has been done in the past with a view to preparing solid sodium hypochlorite. In 1898 Muspratt and Smith succeeded in preparing crystals of this compound. The method was, however, difficult, and the product has not yet been manufactured on a commercial scale.

It was hoped that the introduction of solid sodium hypochlorite would extend the use of this bleaching agent by making its transport and handling easy. The objects aimed at can all be achieved by the use of solid caustic soda and liquid chlorine, and it is possible that since liquid chlorine is now readily available, the use of sodium hypochlorite will rapidly extend.

LIEUT. GORIN JOINS CHEMICAL DIVISION

Frank B. Gorin has recently been named Chief of the Heavy Chemical Section of the Chemical Division, Bureau of Foreign and Domestic Commerce. Mr. Gorin is well known in the industry, having been connected with the Chemical Warfare Service first as an officer in France and later as Chief of the Industrial Relations Division of the Scervice in Washington. In this capacity he made an official survey of the facilities of the American dye and chemical industry, visiting many of these plants throughout the country.

Reproduced Daylight and Quality Production

Discussion of the Situation in Regard to Functions and Types of Daylight Lamps—Importance of Effective Conditions for Controlling Manufacturing Operations—Conditions Governing Utility of Daylight Apparatus and Practical Suggestions on Use—Special Unit for Dyehouses

By HIBBARD S. BUSBY

Consulting Colorist, New York City

IN order that the finer details of materials may be realized and a standard for examining into the quality of the resultant production may be set up, it is necessary that the most rigid means be provided for the inspection of the smallest details and the general appearance of textiles.

Many ingenious devices have been perfected of late for the study and control of such matters. The ultimate field of scrutiny is, of course, the full light of day. Therefore, in so far as this inspection equipment reproduces the quality and properties of average daylight, and is of sufficient illuminating power to guarantee avoidance of eye strain, the ideal of quality examination and scrutiny will have been attained. The market provides various devices whose existence is concrete evidence of realization of the need in industry of such a service.

Essential Characteristics

In general, all these devices possess some of the following essential characteristic elements:

1. A source of light of definite power, regulated by a controlled electric circuit.

2. A reflecting surface to direct the light toward the region or upon the work being examined.

3. A means to modify the color of the source of light, so as to align its color characteristics more truly with the known characteristics of average daylight.

(a) In the form of "mosaics" (patches of glass of various colors which were laid upon a sheet of glass of another color or white). The various colors of these were diffused and mixed into a more or less homogeneous single effect by the sheet of glass upon which they were laid. This glass could be etched or ground.

(b) In the form of a glass filter of such a composition that it represented an approximation of the color of sunlight when the filter was of a certain thickness. In successive thicknesses the filter had the property of approximating the successive intensities of sunlight and color-matching them (i. e., gave an effect equivalent to the effect obtained by raising the temperature of the theoretical "black body" by successive degrees).

(c) In the form of the glass globe (of the lamp itself), commonly known as a "blue bulb." This is still referred to in many places as a "daylight bulb."

(d) In the form of a colored reflector for the light source.

(e) In the form of a group of (single-colored) filters for the light source, placed in successive layers.

(f) In the form of a single-colored (composition) filter for the light source. This filter gave a color effect matching the color of various sky conditions, as "north sky," etc.

Maintenance of Quality

In any such device as a daylight lamp, the first condition of its adaptability to the market is economic. It must be apparent that a fundamental consideration of trade reputation and good-will—indeed, the primary basis upon which continued sales depend—is the certainty and the degree of the quality of the product.

One of the greatest obstacles in the path of guaranteed quality is the danger of acquiescence to a policy of permitting the gradual infiltration of a lowered standard of quality, as an incident to the stress of the primary objective of high-speed production.

This condition of lowered or uncertainly maintained quality is not one which must necessarily be accepted. In the same way that the problem of slow rates of production have been overcome (that is, by the invention of improved devices and methods) we have at our disposal the means to conquer the danger of allowing defective work to pass through unobserved. There are improved and intensified means for the rapid and efficient scrutiny of the product, at a rate amply sufficient to keep pace with its delivery from processes.

Conditions Governing Utility

Any device or method for obtaining these results must stand the tests applied to other machinery utilized in maintaining the standards of high speed and uniformly precise production; that is:

1. Uniformity in character over a large number of units.

2. Simplicity in construction.

3. Ease of operation and repair.

4. Of measurable accuracy and uniformity in performance.

5. Ease of manipulation, for maintenance, cleaning and interchangeability of standard parts used for various sub-divisions of the variety in demand occasioned by the line of product made.

6. Of widest possible range of adaptability within the practical limits of the cost of investment and the performance demanded.

7. Endurance.

Matter of Costs

It must be obvious that within the foregoing considerations the first or installation cost may properly fall within the region of the prices paid for any other highly developed special equipment which fulfills the similar function of handling large volume of work with accuracy and speed.

It is important to remember, also, that such a device as this regulates and confirms the product of many machines of the class just mentioned, hence its real value is many times in excess of its actual cost, just as a micrometer governs acceptance or rejection of the product of lathes, shapers, etc., although its cost is very much smaller than any one of them.

Furthermore, the ordinary inspection methods used in textile mills have progressed very little beyond those adapted to the day and rate of production of the spinning wheel and the hand loom. Therein they act as a positive deterrent on efficient, high-speed output. Production under them is prorated under the slowest, most inconvenient conditions possible of man-hour scrutiny, and its standards of reference are the unsupported opinions of the various examiners employed.

Constructional Features

It is equally important, in considerations of adaptability of this equipment to factory usage, that it shall possess certain structural features applicable to its key position of being the tool of men of practical experience in their own field, but not engineers, and who are in a hurry.

One of these considerations is that it make use of a source of light (a lamp) that is easily obtainable in the open market. In fact, this advantage has the significance of fulfilling one-half of conditions 1, 3 and 4 above.

Also, where the working parts are limited to such a source, with a reflecting surface for directing the light produced, and the simplest reliable agent for modifying the color character of the light source, they fulfill all of condition 2 and the other halves of conditions 1 and 3, as well as all of condition 5.

Condition 6 is aided if the character and placement of the reflecting surface is such as to permit of a fairly large, uniformly illuminated field of operation, rather than a small, highly concentrated one. This enables examination of a large area of work and comparison of standards with any part of the work, without the necessity of moving it about.

The full condition 4 is that, within the above-named limits, the light delivered upon the work be the same for all cases (of the same type of unit) and that this sameness be a very close approximation in character to the light of average natural daylight. The ultimate test of this quality must be the performance record of a large number of units, properly authenticated by reliable observers. Whenever it can be shown from such records that uniform results have been obtained in this way, not only the character of the light but for all practical purposes, condition 7 is met satisfactorily.

Especially where the duplication of all sorts of different types of light is demanded, as artificial house lighting, noon sunlight, north skylight, etc., condition 6 is of great importance, and, with condition 4, practically determines the selection of the unit most adaptable for general mill and merchandising work.

Installation

Some useful types of this equipment have been condemned on the ground that their light was "too bright," or "got in the eyes," or this or that criticism. The sun is too bright, looked full in the face, and very few of us would care to be exposed to its full rays or read this journal in its full glare all the time. Here, as in all things, proper setting and apportionment of the proper quantities for a given use are the elements which make for satisfaction.

A properly planned unit, adapted to the working conditions and demands of the problem, and the practical demands of production, laid out by persons skilled in the use of this equipment and operated as specified, can safely be left to the later care and use of a novice.

Importance of the Problem

The whole motive of the use of daylight equipment, as outlined here, revolves about the point of having proper conditions for executing and controlling the various operations of manufacturing a quality product.

The literature of trade journals, scientific societies and the popular and daily press give increasing evidence of the importance of and the attention that is being paid to the function of proper lighting in production. When the final and natural extension of this problem, the introduction of efficient daylight units into all manufacturing units engaged in quality production is realized, the greatest step in productive-engineering efficiency will have taken place, as well as removal of the last barrier separating the workman from his desire to work and his determination to leave

nothing undone to procure ideal conditions under which to do so.

In view of the figures developed from a recent research, which showed conditions under which illumination produced electrically was less costly than natural daylight, the ambition to light fine-quality operations with electrically reproduced daylight has more than ordinary significance.

Explanation of Illustrations

Referring to the accompanying illustrations, it is a well-known fact of optics that light is reflected from a plane surface at the same angle at which it strikes the surface. Angle A equals angle B (Fig. 1). Yet the significance of this fact is often completely disregarded in making use of daylight lamps and some mill men have been known to complain that such lamps "showed too much luster" on a sheen-surfaced fabric examined under them. As shown in Fig. 2, if the sample is placed in such a position with respect to the lamp that the light from the lamp is reflected directly into the eye of the observer he will get the full reflected strength of the light, or sheen, from the surface of the sample.

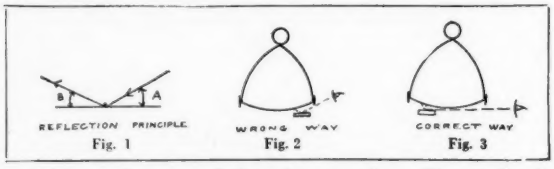

Fig. 1 Fig. 2 Fig. 3

The proper placement of sample, Fig. 3, shows how this is avoided. Incidentally, this very effect is easily duplicated, to a certain degree, under any lamp. It so happens that daylight lamps are built with reflectors designed to send back the maximum of light furnished by their light source. Under such conditions the resulting brilliance of illumination is, of course, much more marked than it is under the ordinary type of lamp in everyday household or office use.

Span of Illumination

It is a matter of vital importance that the area illuminated by a daylight lamp be relatively many times the area of the spot of predominant interest on the sample under examination. This precaution is taken to avoid rainbow effects which so often occur on the edge of a highly concentrated area of illumination, and to promote, in so far as possible, a good degree of uniformity in the intensity of the lighted area. A large part of the latter item is effected by the shape of the reflector and its placement with respect to the light source (See Fig. 4). A further desirable quality is that the intensity of illumination of the lighted area be as high as possible, per square inch of this area, but not in excess of comfortable working conditions for the inspector. This is to enable closer scrutiny of details on the work.

In this sense, it must be obvious that any system of directing the light upon the illuminated area, that is, the

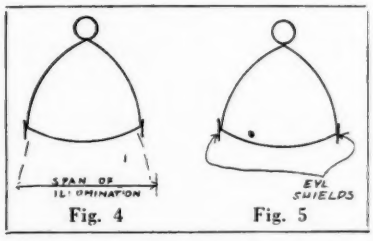

Fig. 4 Fig. 5

reflector, which is so constituted that it produces a different character of light at any two different points within that area, must leave very much in doubt the estimation of any color appearance of the material being examined, because of the obvious tendency to examine the sample at random at any position within this area.

Every one of the daylight lamps on the market today, if looked at directly (in the direction of its light source or its reflecting surface) presents an appearance of color entirely different from the color of the light cast by it upon some white surface, as a sheet of white paper. Therefore, it must be obvious that a highly desirable structural feature of any lamp will be one which introduces an eye-shield or guard (See Fig. 5) between the eye of the inspector and these portions of the lamp, or in any other way makes it difficult, if not impossible, to look directly at these portions of the lamp during the course of examinations of a larger number of samples.

This feature reduces the amount and degree of eye strain attendant upon having to keep the eyes fastened upon the object being examined, instead of allowing them freedom to glance about and thus relieve focus-strain between the examinations.

Referring to Fig. 6, any feature of construction which enables examination of samples simultaneously under both reproduced daylight and artificial (ordinary incandescent lamps) light, has a tremendous practical advantage. In view of the great range of dyestuffs marketed to-day, it is well to realize that match of a dyed fabric is not accomplished, in general, unless the fabric exhibits the match-quality under both daylight and ordinary artificial light. This is because most fabrics are used in both daylight and night light (artificial).

Indeed, from the point of view of the needs of a highly developed and standardized dyehouse, it would be a decided advantage if a special attachment were provided as an auxiliary feature of the daylight equipment, and not as a separate device, which would enable the dyer to observe his sample through a small eyepiece and see, in adjacent positions, the dyed fabric under three types of illumination at the same time, thus Fig. 7.—Textile World

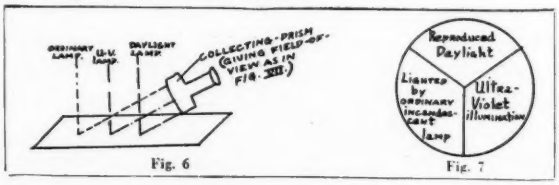

Fig. 6 Fig. 7

Skein Silk Dyeing

Removing the Natural Gum from the Fiber—Four Principal Methods Used for Weighting Silk and Their Limitations—Details of Processes Employed for Each Method—Pure Dye Silks—Fastness to Washing—Dyeing Blacks—Equipment and Size of Batches—Souple Dyeing

By H. R. TISDALE

THROWN silk contains about 20 to 25 per cent of silk gum, and 75 to 80 per cent of pure silk fiber. This gum must be removed, except in cases like souple thread, before the silk is dyed. If the silk is to retain its gum, as in souple silk, the gum is simply softened with hot water and muriatic acid before it is dyed.

To remove silk gum it is necessary to treat the silk in a boiling hot solution of olive oil soap, or other preparation. At the present time, two general methods are used to remove silk gum. The older method is to hang the skeins on dye sticks and then place the silk in a long wooden box containing about 30 per cent of olive oil soap, calculated upon the dry weight of the silk. The silk is moved and turned at regular intervals for from one to three hours, depending upon the size of the silk thread and the hardness of the gum. After the gum has been removed, the skeins must be well washed in hot water before subsequent dyeing operations.

A later method for removing the silk gum consists in placing the silk skeins on metal sticks and then hanging the sticks in a suitable box in which a strong soap solution is placed. The soap solution is brought to the boil and made to foam. The skeins do not touch the soap liquor but the soap foam rises and completely covers the skeins, which are made to revolve by suitable mechanical arrangement. This soap foam apparatus has proved very efficient in removing the gum from the finer sizes of silk yarn. A great saving in time and labor and cost of soap used results by this process. Fine silk can be boiled off in from 18 to 24 minutes by this process.

After the silk gum is removed—called boiling-off or degumming—the silk is washed with hot water to clean the fiber. The silk is now ready to be dyed or weighted, as the case may be.

Weighting Silk

We consider silk with the natural gum in it as weighing 16 ounces to the pound. Now when the silk gum is removed, the silk loses about 25 per cent of its weight, or in other words, our 16-ounce silk becomes 12-ounce silk. The object of the weighting of the silk fiber is to regain this 4 ounces lost through the boil-off, and in many cases the weighting is carried much further than this point as will be explained later.

There are four principal methods used to weight silk, namely: tin, tannin, iron and logwood. From the standpoint of wear and strength, the last three processes are best. Tin-weighted silk will have a better luster than the others, but will not wear so long. Iron and logwood are used only on blacks. I will take up the methods in order.

The oldest method of weighting the silk with tin chloride consists in first washing the silk well after the boil-off and giving a slight sour with a weak solution of muriatic acid. This is to neutralize all traces of soap and alkali. Then the silk skeins are worked for one hour in a 25 to 30 degree Be. solution of bichloride of tin. This operation may take place in a plain wooden box, a lead-lined wooden box, or a rubber-lined extractor. The first is probably the simplest and cheapest for small operations, though the last mentioned is probably the cheapest in the long run on quantity production.

There is still another method in use called the "phosphating machine." In this case the silk skeins are packed in a small metal cylinder, the metal of which is not affected by any of the chemical solutions used. The tin solution is applied, the silk washed and the phosphate solution run in, allowed to run for about one hour, then washed again and the silicate bath applied and again washed. All the time the silk remains in the small metal cylinder and is not touched by the hands. This method of course saves an enormous amount of hand work.

The phosphate of soda solution stands at about 6 degrees Be. and the temperature at about 145 deg. Fahr. The passage of the skeins through the tin solution and the phosphate solution is called a "pass." The silk is given two, three or four passes depending upon the weight desired. The last operation in weighting consists in placing the silk in a hot bath, about 135 deg. Fahr. and 3 deg. Be. strength, of water glass or sodium silicate. This operation will complete the tin-phosphate-silicate compound formed on the silk fiber.

The next operation is to wash the silk well again in hot water and then place it in a hot solution of olive oil soap. About 10 to 25 per cent of soap is necessary to restore the feel to the silk and kill all the surplus chemicals not removed by the washing operations. Silk which has been so treated has had its affinity of picking up further weight nearly exhausted, but its luster is very greatly increased. The use of the silicate seems to prevent the silk from taking up any more weight, and in the case of silk to be dyed black, the silicate bath is omitted because of the fact that the silk which has been treated with tin-phosphate alone will pick up more weight from the solutions used in dyeing black than silk which has been weighted with tin-phosphate-silicate.

Tannin and Logwood

The next process of weighting to be considered is by means of tannin. The tannin is bought in the form of an extract or tannic acid. On colors, the two extracts most used are sumac extrac or China galls. Sumac extract has more coloring matter than galls and is only used for medium or dark shades. Pure silk will only take up 25 per cent of its weight of tannin, and so it is impossible to get more than 16 ounces returned on tannin-weighted goods.

In the case of colors, the tannin is put directly into the dyeing liquor with the acid and boiled-off soap liquor and the silk picks up the weight as the dyeing process is going on. The tannin used does not hurt the wearing properties of the silk and it sometimes makes the color faster to washing. In the case of blacks, the tannin is applied in the form of gambier, divi-divi, cutch or quebracho extracts. These are generally used over an iron mordant, that is, the silk is first put into a bath of nitrate of iron—commercial red iron—then washed and put in the weighting liquor, then dyed out with hematine and soap.

The use of logwood as a weighting medium is of comparatively recent origin. The fact that logwood, over a suitable mordant, such as tin-phosphate, could be used to increase the weight of the silk was first worked out by a German chemist named Heermann in 1909. He found out that the amount of the increase in weight was directly proportional to the amount of the tin-phosphate used as a mordant. This knowledge was not generally used by the dyers until some years later, but for the last 10 years the method has been used by nearly all the black dyers.

Logwood can be used to obtain additional weight when used over an iron mordant, though the increase in weight is not as great as when tin-phosphate is used. It has the other advantage, though, in that a good looking black is obtained without the use of anilines and the destructive action of the tin is eliminated. The use of either method —tin or iron—with logwood also has many practical advantages in that the fiber increases in size and will contain more vegetable weighting matter and less metallic weighting. This method gives a strong, fluffy thread and will make a piece of goods with a firm and full feel.

Pure Dye Silk

A great deal of the silk is dyed what we term "pure dye," that is, it is dyed with an aniline dye which does not increase in weight. This is the simplest method of dyeing. The silk is simply boiled-off, as noted before, then washed, then put into a liquor made from the old boiled-off soap solution obtained from the boiling-off process, acidified with sulphuric acid, acetic acid or formic acid, and whatever aniline dye is necessary to produce the shade desired. After dyeing, the silk is washed in cold water and sometimes given a finish of acetic acid and olive oil emulsion made from olive oil and sal soda.

In dyeing with tannin, the silk is treated as for a pure dye and the sumac or galls extract added directly to the dye bath. Tannin dyeing does not present many difficulties. One must figure on the yellow coloring matter present and hold back on the aniline yellow to be used. In case the shade will stand only the slightest amount of yellow, then tannic acid must be used.

In dyeing silk which has been weighted with tin-phosphate-silicate many precautions are necessary. The dyeing bath is made up as for a pure dye liquor; it must not be too hot at the start, not over 130 deg. Fahr., and not too much acid, though more acid is necessary than in dyeing pure dye silk. Again, certain dyestuffs will not work on tin-weighted silk, or if they are used they will wash off when the silk is washed after dyeing and this will change the shade. Unless extra precautions are taken to see that the silk is thoroughly boiled-off, and worked well while in the tin shop, it will be difficult to obtain an even dyeing.

The silk shade should be quite even after the third set in; if not it is best to test the liquor for low acid. Generally the addition of a slight amount of acid and a raise of the temperature will bring good results. After dyeing, the silk is washed with cold water, and given a finish bath of acetic acid and olive oil emulsion. The acid tends to give the silk a scroop and brightens the shade. The oil tends to overcome the friction and prevents static electricity from developing when the silk is later wound onto bobbins or spools. Tin-weighted silk should never be dyed in a boiling hot acid dye liquor, as the hot acid will not only remove some of the weighting material but it will also make the silk tender.

Fastness to Washing

In dyeing silk to stand washing, a different class of dyestuffs is used than that used on pure dye or tin-weighted silk. The silk when dyed must stand repeated washings in soap and also stand pressing with a hot flatiron. Some shades are dyed with fast direct dyestuffs in a bath of water and glauber salt. But this method will only answer for light and medium shades; darker shades must be either developed or mordanted with alum and dyed with alizarine dyestuffs.

The developed dyes should be done in a dark room as the chemical compounds first formed are very sensitive to light and will be destroyed and the resulting color will not be fast. Sometimes a combination of the developed dye and the alizarine dye is used to obtain the desired fast color.

The dyeing of blacks is a subject concerning which volumes might be written. There are hundreds of shades of black. The lightest weight black that can be dyed is dyed with an aniline dyestuff. This gives a thin-looking black when compared with a logwood black and will return about 12½ oz. for weight. A black does not necessarily have to strip with oxalic acid in order to be pure dye. The aniline black will not strip, but is the truest "pure dye" black that can be obtained. A black

which strips to a yellow bottom with oxalic acid has had iron which shows up after stripping, showing that the silk has not been dyed strictly pure dye.

Test for Pure Dye

The surest test for a "pure dye" silk, excepting a chemical analysis, is to burn a small portion. If it sputters and burns readily, leaving only a little ash, it is a pure dye. If it burns with difficulty and leaves a gritty ash, it has had some metallic substance in it. If it is heavily weighted with tin or iron, it may not burn at all, but simply glow and leave a white or brown ash.

The next class of blacks after the pure dyed or acid dyed blacks, are those which will return about 13 or 14 ounces; that is, an increase of 1 or 2 ounces over the boiled-off weight. There are several methods in use to obtain a 13 or 14-ounce black. All of them start with a red iron or "nitrate of iron" bath, then the material may go direct into hematine, fustic and soap to be dyed black, or after the iron bath it may be placed into a liquor containing fustic and gambier, and after washing dyed out with hematine and soap. The latter method gives a fuller and richer black. The shade obtained will depend upon the percentage of fustic, gambier, hematine and soap used and also the temperature. It will be noted that the materials, excepting the iron are all vegetable and do not harm the silk.

The next heavier weights may be obtained either with iron and logwood, iron and osage orange, iron and gambier, or tin-phosphate and logwood. Up to 18 ounces it is not necessary to use tin-phosphate, but the weight can be obtained by the use of iron and logwood. Heavier weights than 18 ounces are more easily obtained by giving two or three tin-phosphate passes and then using logwood. A black secured by this method has a small amount of metallic weighting but a large amount of vegetable weighting matter in proportion to the total amount of weight.

From the standpoint of wearing qualities the use of the weighting logwood is to be recommended, rather than a large amount of tin-phosphate with hematine. As high as 32 ounces return weight can be obtained by this method, and the silk so treated has increased properties for picking up more tannin. By placing the silk, first mordanted with tin-phosphate and dyed with logwood, into a gambier bath, 36 to 38-ounce return weight can be secured.

It is interesting to note that for weighting purposes hematine will not replace logwood. Though both hematine paste and logwood extract are made from the wood of the logwood tree, by boiling the chip wood with water, logwood is supposed to be unoxidized and contains a large percentage of hematoxylin, while the hematine paste and logwood extract are made from the wood of the logwood tree, by boiling the chip wood with water, logwood is supposed to be unoxidized and contains a large percentage of hematoxylin, while the hematine paste contains a large proportion of oxidized hematoxylin or hematine. It is possible, however, to use logwood extract in obtaining a weighted black silk without using hematine paste. The reason is that the logwood first gives up its weighting principle to the silk fiber and then through the heat of the dyeing operation and the action of the air, the logwood is oxidized to hematine and we get our black color.

Dyeing Blacks

As black is a stable shade of the silk dyer, I will give a few methods of securing a black on silk. The simplest black on silk is obtained by treating the boiled-off silk in a bath containing about 10% old boiled-off soap liquor to which has been added enough acetic or sulphuric acid to have the bath taste sour. Then add about 8% of a good acid black. Bring to the boil and boil for one-half hour; wash and finish as desired. This will give a black fairly fast to light, but it will not stand repeated washings with soap.

A black fast to hot soap washing can be secured by first dyeing the silk with a developed black, washing, then diazotize with nitrite of soda 8% and muriatic acid 6% in the cold. Wash and develop in warm bath with beta-naphthol or metaphenylene diamine. This gives a black which can be boiled in a soap bath without changing the shade, but it again is not fast to light.

Hematine or logwood blacks here come into their own, in that they are fast to light and will stand repeated washings with soap. It is true that a hematine black will turn the warm soap wash water a light pink color, but the reduction of the shade is very slight, due to the richness and depth of the black. On hosiery, for instance, it does not have to be exposed to light when worn, but the stocking has to be washed frequently and an exposure to light when wet is more severe than when dry.

A simple black on silk with hematine would be about as follows: After boiling-off the gum and washing, place the silk in a bath of "nitrate of iron," 20 deg. Be. strength, for one-half to one hour. Wash well in cold water and then hot water to set the iron. Then place in a bath made up of 50% hematine paste, 50% fustic extract, and 50% olive oil soap. Start dyeing warm, raise to the boil and boil about half an hour. In this particular formula, logwood extract may be used in place of the hematine paste. After dyeing, the silk is washed well with warm water and finished with acetic acid and olive oil emulsion.

Some dyers prefer to put the fustic on in a separate bath, and they add about 15% gambier extract to the fustic. This is put on at the boil for about one hour, then washed and the silk dyed out with about 50% soap. Gambier works better than other tannin bearing extracts and gives a richer looking black.

The question of hand work or mechanical apparatus for dyeing is largely one of size of batches and production. In a small dyehouse where the size of the dye lots runs up to not more than 25-pound batches, hand work in a copper tub is probably the quickest. But when the batches run to 50 pounds or over there is no doubt that the machine dyeing is the better.

(*Concluded on page 702*)

AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

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Published biweekly by
HOWES PUBLISHING CO., INC.
4109 Woolworth Building, New York City

A. P. HOWES, *President* E. S. PREDMORE, *Secretary*

Subscription price $5.00 per year; Canadian $5.50; foreign $6.00

Vol. XII September 24, 1923 No. 20

AN IMPORTANT DECISION

ELSEWHERE in this issue (pg. 702) there appears a complete account of the decision rendered by Board 3, U. S. General Appraisers, in the case of an appeal brought to the Board by the Government seeking a reversal of a ruling made by Judge Brown to the effect that an imported Neo-Salvarsan was not competitive with the similar American product. Judge Fischer, writing an opinion unanimously concurred in by other members of the Board, reverses Judge Brown and upholds the original appraiser in his contention that the imported product is "similar to or competitive with the domestic product of the same name."

A paragraph in Judge Fischer's decision which should be of far-reaching effect upon the American dyestuff manufacturing industry, as indicating the disposition of the Board of General Appraisers in matters where imported dyestuffs are admittedly similar but not necessarily identical in all respects to the American products, is as follows:

"At any rate, in considering a statute of this kind we believe that the rule of reason should prevail. Certainly, the law does not demand proof of exact equality in results accomplished as a condition precedent to qualifying a coal-tar product under paragraph 28 and applying thereto the American selling price as the prescribed method of appraisement. Some recognition should be given to the fact that the provision only contemplates foreign articles which produce results substantially equal to those accomplished by domestic products."

In other words, this decision would seem to support unequivocally the contention put forward by American dyestuff manufacturers that the American product should be the basis of comparison against which foreign products should be judged, and that it is not the intent of the law to require American products to be compared at every point with foreign products offered for entry.

Hence, it would appear that where an imported product accomplishes substantially the same results as a domestic product when used for the purposes for which the American product is used, it is immaterial whether the imported product may also be used for some purposes for which the American product is unsuited.

This decision by the Board of General Appraisers is most gratifying to those who have steadfastly upheld the American dyestuff industry in its struggle for development. It was unquestionably the intent of Congress in passing the recent tariff legislation that domestic products should be protected by a duty based on the American selling price when foreign products suitable for the same purposes were offered. There are, of course, countless fine points in the administration of any law where hostile or friendly interpretation may make a tremendous difference in the results accomplished. It is most gratifying, therefore, to find that the Board of General Appraisers is evidently determined to uphold the intent of Congress and will not be easily led astray by attempts to becloud the issue with minor technicalities.

NEGLECTING SAMPLES

A SEEMINGLY trifling but, in the aggregate, really serious difficulty with which dyestuff manufacturers and dealers have to contend in introducing their various products is the very common lack of interest with which their product samples are treated by the consumers.

There are a few well-organized mills which have a fixed policy of testing all samples submitted promptly, advising the one who submitted the samples of the results of such tests and filing the results for future reference. Unfortunately, however, such mills are in a very small minority.

The common custom when a dyestuff salesman calls upon a dyer is for the latter to request samples of any products which might sound in the least interesting and having received the samples put them to one side and forget the matter. This is obviously very poor business from every standpoint. It means that the dyer is not informed of the merits of products which, in many cases at least, might prove of distinct value to him and his mill. It means that his office and laboratory are cluttered up with a lot of miscellaneous samples which serve no purpose other than to interfere with the efficiency of other necessary operations, and it means in the aggregate a very serious wasted expense on the part of the dyestuff distributors, who must, of course, charge this sampling cost as part of their general overhead, which necessitates passing this charge along to the consumer.

This condition exists because of two chief reasons. The first is that it is one of the easiest ways to dismiss a salesman in whose products a dyer does not believe

himself to be interested; the second is nothing but mere laziness or lack of efficiency on the part of the dyer and his laboratory assistants. This latter condition is probably no worse in the dyehouse than it is in any business office. But it is unquestionably true that a business concern whose routine work is handled promptly and expeditiously, and whose files are clean and up to date, is in a much better position to conduct its affairs than one where slipshod methods prevail. An excellent resolution for every purchaser of dyestuffs to make and, having made, to fulfill would be as follows:

"I will not ask or accept product samples unless I believe there is at least a fair possibility that they may be of real interest to me. Having received such samples, I will see that they are tested promptly, the submitter notified of the results of the tests, and the information filed for further reference."

If every dyer would follow this practice he would soon find that he was discovering products whose qualities or money value recommended them to his use. His office and laboratory would be a far more efficient place in which to work, and the dyestuff distributors would be spared tremendous effort and expense, which in the long run must go toward increasing the cost of all dyestuffs—the elimination of which expense would react directly for the benefit of all consumers.

STANDARD METHODS OF TESTING

As a corollary to the subject of samples, discussed above, a word might be said as to the necessity of establishing standard methods of dye testing. We have recently had called to our attention several instances wherein various laboratories have reported widely differing results from tests of the same dyestuff. In fact, it is almost the rule that where half a dozen reports on the same product are turned in by six different testers, at least one or two of them will be away out of line with what was to be expected.

This condition can only result from one of two causes: either the methods employed for testing were widely different, or the work itself was very carelessly carried out.

The latter trouble, of course, is one which can only be overcome by the selection of competent and careful laboratory operators, and would be present even though uniform methods of testing were adopted. The former difference, however, could easily be eradicated by the universal adoption of standard methods of testing all samples.

The American Association of Textile Chemists and Colorists is to be congratulated upon the efforts which it has made in this direction. Provisional methods for the testing of dyes for fastness to washing and other agencies upon various fibers have been adopted, and methods of testing for fastness to light will shortly be published. It would be tremendously for the good of the industry if these methods could be accepted by all dyestuff users and be put into universal operation. A great deal of the unsatisfactory and misleading reports from dye tests which currently exist would thereby be eliminated.

TRIBUTE TO FRED E. SIGNER

At the meeting of the Board of Governors of the Synthetic Organic Chemical Manufacturers' Association held September 19, 1923, the following resolution was unanimously adopted:

"Mr. Fred E. Signer, who at the time of his death was Chairman of the Board of Governors of this Association, by reason of his devotion to the cause of upbuilding and sustaining the organic chemical industry, his enthusiasm and personal integrity, was held in the very highest esteem by his associates; be it therefore

"Resolved, That in his death the Synthetic Organic Chemical Manufacturers' Association has lost one of its most efficient workers, and the Board of Governors a loyal friend and fellow officer; be it further

"Resolved, That the deep sympathy of the members of the Association and of this Board be conveyed to his family, and, furthermore, that a copy of this resolution be forwarded to the company of which he was an officer."

SEIZED GERMAN DYES NOT TO BE DUMPED HERE

According to advices received at the office of the Synthetic Organic Chemical Manufacturers' Association, American manufacturers have nothing to fear from the sale of the French-Belgian seized dyes, assurances to this effect having been received from both Trade Commissioner Breithut at Paris and from representatives of the Department of State to whom the situation was presented by the association.

According to the best available information, the inventory completed during the last week in August showed that the total seized tonnage amounted to approximately 5,400 metric tons, of which Belgium and France received 2,300 tons for home consumption. It was expected that the remaining 3,100 tons would be sold at auction, but later advices indicate that these sales are being handled by the French and Belgian producers, the Belgian share going to Lazard Godcheaux, of Brussels, and the French share distributed through the Syndicate Francais des Producteurs des Matieres Colorantes—probably 80 per cent through the Compagnie Nationale, 15 per cent through the Saint Denis and the remaining 5 per cent through the smaller French companies. Reports indicate that the products will be sold gradually. Of the 3,100 tons of surplus dyes, 1,150 tons consist of indigo, which will

undoubtedly find its way into the Chinese market. Of the remaining 1,950 tons, about 50 per cent is considered competitive with American products. It is understood that there is a demand from many countries much greater than the supply, assuring high prices.

SKEIN SILK DYEING

(*Continued from page* 699)

Souple Dyeing

There remains one more subject to take up, and that is the question of souples. Souple dyeing suffers from the other forms of dyeing in that the gum is not boiled off before dyeing. Souple silk retains the four ounces of gum as weight. To prepare the silk for dyeing, it is placed in a hot bath containing water and a small amount of sulphuric acid, and is worked in this bath until the gum is softened. After softening, in the case of blacks, it is put in the nitrate of iron bath and the work carried out the same as for a silk without the gum. Other kinds of blacks are treated differently. After softening it may be placed in a bath containing tannin, such as divi-divi, quebracho or cutch. In these liquors it will increase in weight, depending upon the amount given. After that it is dyed out the same as a pure dye, except that the bath is not made very hot.

In the case of colored souples, most of the softening process goes on in the dyeing operation, though the silk has to be first wet out with warm water and acid. Sumac extract is also used with souples to increase the weight. As high as 20 ounces may be obtained on souples with sumac, but this may be secured only in case of medium and dark colors, for here, too, the yellow coloring matter plays its part. Light colored souples must be first weighted with tin-phosphate-silicate before dyeing to obtain over 16 ounces return weight.—Textile World.

NEWPORT DINNER AND THEATER PARTY

The executives and salesmen of the Newport Chemical Works held their annual dinner in the Blue Room of the Hotel McAlpin, Thursday evening, September 20. The dinner was preceded by an all-day sales conference. Twenty-eight members of the Newport organization and two guests comprised the gathering. After an excellent dinner the party adjourned to the Casino Theater to witness a performance of "Wildflower."

Chemists Club Anniversary

The Chemists Club, New York, will celebrate the silver anniversary of the founding of the club. Arrangements are in charge of A. A. Holmes, E. G. Nellis and H. W. Spicer. The tentative date has been set for October. Dr. William H. Nichols, one of the charter members of the club, has consented to preside.

UNITED STATES SELLING PRICE UPHELD IN NEO-SALVARSAN CASE

Appraisers' Board Holds This Article to Be Competitive with Foreign Product

On an appeal brought by the Government to Board No. 3 of the United States General Appraisers, the Board has unanimously ruled that the foreign product is a coal-tar derivative "similar to or competitive with the domestic product of the same name." This ruling is an affirmation of the original appraisal and a reversal of a decision by Judge Brown, who had held, on appeal from the original appraisal, that the imported product was non-competitive, and therefore not dutiable on the American selling price. Comment on the effect of this decision as regards dyestuffs is contained in the editorial columns of this issue of The Reporter.

The opinion of the Board, written by General Appraiser I. F. Fischer, is as follows:

The merchandise in question is known and sold as neo-salvarsan. It was appraised on the basis of the American selling price of a domestic product similarly known and sold, but on reappraisement the entered value thereof was sustained. The Government now applies to this board for a review of said reappraisement on the record therein made.

It is not denied—if it is not indeed tacitly admitted by both parties hereto—that the merchandise is a coal-tar product.

Now, paragraph 28 of the Tariff Act of 1922 provides that the duties therein imposed shall be—

> based upon the American selling price (as defined in subdivision (f) of section 402, Title IV) of any similar competitive article manufactured or produced in the United States;

and, further, that:

> for the purposes of this paragraph any coal-tar product provided for in this act shall be considered similar to or competitive with any imported coal-tar product which accomplishes results substantially equal to those accomplished by the domestic product when used in substantially the same manner.

Section 500 of said act charges the appraiser with the duty of appraising imported merchandise by "ascertaining or estimating the value thereof by all reasonable ways and means in his power," and directs that he "describe the merchandise in order that the collector may determine the dutiable classification thereof." This the appraiser evidently did when he found the present merchandise to consist of a coal-tar product bearing a well-known trade name, and that

said product was "similar to or competitive with" a domestic product of the same name.

Such findings of fact and the resultant conclusions of law this board, on the record before it, is unable to disturb, the evidence submitted by the importers being deemed insufficient to overcome the presumptive correctness which attached to the action of the appraiser. On the contrary, the record supports the conclusions reached by that official, in that it contains the following uncontradicted testimony of Dr. Carl J. Hertzog:

> Q. You personally, were you personally engaged in the manufacture of neo-salvarsan by H. M. Metz & Co.?
>
> A. I was during the war, and actually made the salvarsan and the neo-salvarsan up to 1919.
>
> * * * *
>
> Q. Have you ever seen the article like Exhibit 1 manufactured in Germany?
>
> A. I did.
>
> Q. And is it that same article, that Exhibit 1?
>
> A. It is.
>
> * * * *
>
> Q. Where did you see it made, doctor?
>
> A. I saw it made in Germany and I saw it made here.
>
> * * * *
>
> Q. And do they use the same formula?
>
> A. They do.
>
> Q. That they used some years ago?
>
> A. We do, exactly the same formula.
>
> Q. Is it the same or different from the one you saw in use by Farbwerke?
>
> A. It is exactly the same.
>
> * * * *
>
> Q. You are familiar with its composition over a term of years?
>
> A. I am.
>
> Q. Can you say that the articles are the same?
>
> A. Yes.
>
> Q. Chemically?
>
> A. Chemically, yes.
>
> Q. And are they identical, doctor?
>
> A. We claim that—yes.
>
> Q. Well, are they, as a matter——?
>
> A. They are chemically identical with the product made abroad by the German manufacturer.

True, there is also some testimony in the record by a physician alleging different results obtained by him from the use of the foreign as distinguished from the domestic product. But it may well be that these clinical variations were due largely to the physical condition of the different patients undergoing treatment. We certainly believe that some allowance should be made therefor, especially in view of the physician's testimony that the condition of the patient had a material effect on the results accomplished.

At any rate, in construing a statute of this kind we believe that the rule of reason should prevail. Certainly, the law does not demand proof of exact equality in results accomplished as a condition precedent to classifying a coal-tar product under paragraph 28 and applying thereto the American selling price as the prescribed method of appraisement. Some recognition should be given to the fact that the provision only contemplates foreign articles which produce results substantially equal to those accomplished by domestic products. As was said by Woodbury, Circuit Judge, in Adams vs. Edwards (1 Fed. Cases, No. 53, at page 114):

> . . . And I do not say, as one of my brethren upon the bench has said, that there is no definite signification to the word "substantial." When we say a thing is substantially the same, we mean it is the same in all important particulars. It must be of the same material when material is important; it must be of the same thickness when thickness is important; it must be applied in the same way, condition and extent to the doors as well as the sides when either of these circumstances makes an essential difference.

In Hobbs vs. Beach (180 U. S., 383, at page 400) the United States Supreme Court, in construing the words "substantially as described or set forth," said:

> Without determining what particular meaning, if any, should be given to these words, we are of opinion that they are not to be construed as limiting the patentee to the exact mechanism described; but that he is still entitled to the benefit of the doctrine of equivalents, and that it is still true, as observed in Morley Sewing Machine Co. vs. Lancaster, 129 U. S., 263, 273: "Where an invention is one of a primary character, and the mechanical functions performed by the machines are, as a whole, entirely new, all subsequent machines which employ substantially the same means to accomplish the same results are infringements," although the subsequent machine may contain improvements in the separate mechanisms which go to make up the machine.

And in Electric Candy Machine Co. vs. Morris (156 Fed., 972) it was held that "authorities concur that the substantial equivalent of a thing in the sense of that patent law is the same as the thing itself; so that if two devices do the same thing in substantially the same way, and accomplish substantially the same result, they are the same, even though they differ in name, form or shape." Machine Co. vs. Murphy, 97 U. S., 120, 24 L. Ed. 935.

Again, in the case of Cantrell vs. Wallick (117 U. S., 689), wherein the court said:

It may be true, as contended by the defendants, that the device used by them is in some respects better than that of the plaintiff, but this cannot relieve them from the charge of infringement if the devices are substantially alike. The rule was well stated by Mr. Justice Clifford, in delivering judgment in the case of Machine Co. vs. Murphy, 97 U. S., 120, 125, where he said that "in determining the question of infringement the court or jury, as the case may be, are not to judge about similarities or differences by the names of things, but are to look at the machines or their several devices or elements in the light of what they do or what office or function they perform, and to find that one thing is substantially the same as another if it performs substantially the same function in substantially the same way to obtain the same result."

The patent law abounds in decisions of like tenor, and under them the foreign neo-salvarsan here under discussion could scarcely escape the charge of infringement, if its competitive domestic product were manufactured under letters patent, since it is clear from the evidence that the two are identical in chemical composition. We cannot see why they should be deemed less identical for tariff purposes.

Therefore, on the evidence submitted we find (1) that the imported neo-salvarsan is a coal-tar product, and (2) that it is similar to or competitive with the domestic product of the same name in that it "accomplishes results substantially equal to those accomplished by the domestic product when used in substantially the same manner," and we accordingly hold as matter of law that the appraiser correctly based his valuation thereof on the American selling price of said domestic product, as prescribed by statute.

The decision of the general appraiser is reversed and the appraised value affirmed.

BYRON S. WAITE,
W. C. ADAMSON,
I. F. FISCHER.
Board 3, United States General Appraisers.

ACTIVITIES OF THE SALESMEN'S ASSOCIATION OF THE CHEMICAL INDUSTRY

The annual golf tournament of the Salesmen's Association of the Chemical Industry was held at the Ardsley Club on Tuesday, September 18. Thirty-seven members competed. Prizes were won as follows:

Low Gross—First prize (silver pitcher), A. H. Pierce, score 88; second prize (wallet), Charles H. Stone, score 90; third prize (Dunhill pipe), A. M. Taylor, score 92.

Low Net—First prize (cigarette case), W. R. Melville, score 70; second prize (dozen golf balls), John Black, score 71; third prize (flask), A. J. Higgins, score 76.

Low Net (for handicaps of 20 or more)—First prize (Dunhill pipe), W. F. Tuttle, score 78; second prize (jewel case), H. T. Edgar, score 79; third prize (bill fold), R. E. Dorland, score 84; fourth prize (cigarette case), R. J. Quinn, score 84.

Kickers' Handicap—Prize, cigarette box; won by J. A. Kilcommons, score 78.

Others who played were: Frank L. McCartney, W. H. Hendricks, R. C. Anthony, C. A. Beach, H. C. Russ, R. H. de Greef, John W. Boyer, R. C. Hedke, O. N. Berndt, Charles B. Hall, W. H. Adkins, J. D. Lowery, W. B. Thom, E. W. Bartram, H. M. Miner, E. A. Hultz, N. Neville, E. E. Louth and R. P. Dunning.

The committee in charge consisted of Ray P. Dunning, chairman; John W. Boyer, A. H. Pierce, Philip M. Dinkins and George M. Dunning.

Money for prizes was contributed by the Oil, Paint & Drug Reporter, Chemical & Metallurgical Engineering, Drug & Chemical Markets, Chemical, Color & Oil Record and the Chemical Exposition.

At the annual meeting and luncheon, which was held at the Hotel Commodore Thursday, September 20, the following officers were elected for the coming year: President, Ralph E. Dorland; first vice-president, E. A. MacKinnon; second vice-president, George Bodie; third vice-president, David Stewart; secretary, A. J. Binder; treasurer, George Ashworth; executive committee, George M. Dunning, D. H. Killeffer and F. L. Hensler, the latter to fill the unexpired term of Mr. Dorland, who was elected president.

The annual dinner of the association was held at the Hotel Commodore on Thursday evening. Upward of three hundred members and guests were present. Dr. C. H. Herty presided as toastmaster. The first speaker was Major-General Henry T. Allen, Commander of the Army of Occupation at Coblenz, who spoke on the economic conditions existing in Europe at the present time and advocated the development of the American chemical industry as an insurance measure for the production of gases for warfare. The second speaker was Dr. Edgar F. Smith, former president of the American Chemical Society, whose talk was in the way of reminiscence covering the development of the American chemical industry.

JAPANESE CHEMICAL MARKETS

The Chemical Division of the Department of Commerce recently published a report from Consul Dickover, at Kobe, Japan, on the Japanese market for heavy chemicals and dyestuffs, from which the following paragraphs are quoted:

In the heavy-chemicals and dyestuffs trade of Japan the United States has not held the position which it gained during the war, with the single

exception of the trade in sulphate of ammonia. For other heavy chemicals and dyestuffs Japan is now turning to England and Germany, principally because better prices can be had from these countries.

* * * *

The Japanese market for heavy chemicals and dyestuffs improved considerable during 1922, since the large surplus stocks of industrial chemicals, carried over from the post-war speculative period, were gradually becoming depleted, while the comparative prosperity of the cotton, silk and wool spinning and weaving industries maintained the demand for dyestuffs.

* * * *

Phenol—The importation of phenol into Kobe and Osaya was steady and comparatively large during 1922, although the lack of the speculative element in the purchase of this commodity prevented any wild pyramiding of orders, as so often happens in Japan. The United States has lost its share of this trade, having shipped only 2 per cent of the total imports in 1922, as compared with over 50 per cent in 1920. Great Britain is now supplying the bulk of the carbolic acid used in Japan.

* * * *

Dyes—The trade in aniline dyes was prosperous during 1922. Germany, as was to be expected, has recaptured the bulk of the trade, supplying 86 per cent of the aniline dyes imported into Kobe, while the United States sent only 8 per cent, whereas in 1920 the United States furnished 65 per cent and Germany 16 per cent of the total imports.

* * * *

American artificial indigo has not been so completely overshadowed by German supplies, but even in this case Germany furnished over 50 per cent of the 1922 imports into the Kobe consular district, the remainder coming from the United States and Great Britain. Naturally, the exchange situation has assisted Germany to a very great extent, while the substitution of a high ad valorem duty for the former low specific duty on aniline dyes coming into Japan has intensified the difference in price and rendered it more difficult to market American dyestuffs here. It is expected, however, that these handicaps to the importation of American dyestuffs will be partially removed in the course of time.

NINTH EXPOSITION OF CHEMICAL INDUSTRIES

The Chemical Exposition for 1923 came to a conclusion at Grand Central Palace on Saturday evening, September 22. The exhibitors numbered around three hundred, the attendance throughout the week was approximate to that of last year, and the exposition as a whole was of very similar character. It is undoubtedly a wise decision on the part of the management not to attempt the holding of another show in 1924, but to produce the exhibit at two-year intervals in the future. Consistent exhibitors have found so little of really novel interest arising in the course of a year that they have found it impossible to make the recurring expositions assume much in the way of new features.

The one outstanding exception to the above statement was the educational exhibit conducted jointly by the Synthetic Organic Chemical Manufacturers' Association and the Dyes Section of the American Chemical Society. This exhibit was a distinct innovation wherein were showed many examples of fabrics dyed with American dyes, which were unqualifiedly warranted for fastness by their manufacturers. There were also cotton garments in a great variety of fabrics which had been washed fifty times or more and which were displayed side by side with identical garments which were unlaundered, which comparison brought out strongly the fact that the dyes were entirely unaffected by the repeated washings.

These oft-laundered garments were displayed at intervals on living manikins, accompanied by a discourse on the fastness of American colors, which aroused very real interest on the part of the large audiences which gathered to view and to listen. Actual laundering of the garments was continuously carried on before the eyes of the visitors in apparatus loaned by the American Laundry Machinery Company and operated by a representative of the Laundryowners' National Association.

This is the sort of educational work which should have been instituted under some sort of joint auspices several years ago, and which has been repeatedly advocated in the columns of The Reporter. It is to be hoped that work of this type will be continued on every possible occasion.

Aside from the booth above mentioned, the Chemical Show was decidedly lacking in interest to manufacturers or consumers of dyestuffs. Only two dyestuff houses, Jennings & Co. and Bachmeier & Co., exhibited, and it was apparent that only a relatively small percentage of those attending the show were interested in textile-chemical problems.

ADDRESSES ARE ESSENTIAL TO ALL ADVERTISEMENTS

The U. S. Post Office has directed a letter to all publishers which it requests be given publicity. The obvious advantages of the suggestion made therein needs no amplification. The letter follows:

September 18, 1923.

Publisher, My Dear Sir:

In about 50 per cent of the advertisements which appear in newspapers and magazines the advertiser's name and city are printed at the bottom of the advertisement, the street address being omitted. The omission of the street address from mail sent to the advertisers not only

imposes a constantly increasing burden upon the post office, but seriously interferes with the prompt disposition of such mail; in fact, nondelivery is often the result of the failure to furnish a complete street address.

About 80,000 pieces of mail, exclusive of those addressed to the largest and best known firms, are received at this post office daily without street address, and this condition is true in a greater or less degree in all of the larger post offices in the country. The delivery of this incompletely addressed mail is delayed from 8 to 24 hours. Much of the mail sent in response to advertisements is first distributed in railway post offices. The distributers on the trains know their schemes of distribution by street and number, but are not familiar with the street address of even some of the largest firms. A letter bearing a complete street address can be boxed or distributed to the point of delivery and the package sent directly to that point, thereby insuring its prompt delivery. If there is no street address on a letter it can not be sent direct to the delivering station; such mail is tied in packages and sent to the General Post Office where it must be turned over to the expert assorters. These experts dispose of as much of the mail as they can and after they have handled it there are about 20,000 pieces the addresses for which must be searched for in the directories, and of that number as many as 10,000 remain undelivered.

The importance of including the street and number in addresses for mail matter is increasing every day. As our great cities grow, the necessity for specific local directions becomes more pressing.

In no city is the need for specific addresses greater than in New York. The city is so large, its growth is so rapid and the changes so frequent, that it is physically impossible for postal employees to memorize the names of the thousands of hotels, apartment houses and office buildings that abound, to say nothing about the names of business concerns.

If advertisers do not include in their advertisements the complete address that will assure delivery of mail sent as the result of such advertisements, not only will the burden of disposing of this mail continue, but the advertiser will lose the business which he is seeking by reason of delay or nondelivery of the replies.

I am sure that if you will point out to the advertisers in your publication the benefit to them to be derived from the use of a complete street and number address in their advertisements they will recognize that it will be to their interest to include the street and building number and will arrange to have this information shown even though in some cases it may require an extra line in the advertisement.

Sincerely yours,
E. M. MORGAN, Postmaster.

ENCOURAGING EXPORT FIGURES

An announcement from the Chemical Division of the Department of Commerce showed an expansion of 48 per cent in exports of chemicals and allied products in the month of July, 1923, as compared with July, 1922. The chief gains were in the coal-tar chemical groups, rising from a total valuation of $898,638 in July, 1922, to $1,922,987 in July, 1923. July, 1923, exports of coal-tar colors, dyes and stains by countries are summarized in the following table:

	Pounds	Dollars
Belgium	14,925	$4,090
Canada, Maritime Prov.	13,759	3,755
Quebec and Ontario	102,097	63,835
Mexico	7,980	4,971
Cuba	7,838	3,549
Argentina	15,710	7,595
British India	57,297	27,154
China	2,005,741	400,946
Japan	652,593	228,199
British South Africa	9,303	9,758
All other countries	28,288	24,316
Totals	2,915,531	$778,168

ONE-THIRD YOKOHAMA SILK STOCKS SAFE

A letter received September 18 by the Silk Association of American from the Textile Division of the Department of Commerce contains news of the Japanese silk situation from Trade Commissioner George C. Howard, of Kobe. A cable sent to the department by the commissioner reports that "Silk exports since the disaster are moving toward Kobe. It is estimated that approximately 15,000 bales of the total 45,000-bale stocks at Yokohama are safe. A committee has been appointed to determine prices for export before the establishment of a silk exchange at Kobe. It is thought that 5 per cent of the present crop will be early. Normal operations are expected to be resumed as soon as banking and conditioning houses have been completed, and it is thought by local merchants that the silk industry will not be greatly affected."

PATENT SUITS ON WILMINGTON CALENDAR

Five suits brought by German dye and chemical interests seeking to recover royalties on German patents now operated under leases by the E. I. du Pont de Nemours & Co., Inc.—Frank White, Treasurer of the United States, co-defendant—are among the important cases listed for trial under the calendar which opened on September 11th before Judge Hugh M. Morris in the United States District Court at Wilmington, Del.

DIRECTOR GREEN RESIGNS

A special cable dispatch to the Journal of Commerce states that Prof. Arthur G. Green, research director of the British Dyestuffs Corporation, has resigned, owing, it is said, to his belief that lack of technical knowledge on the board of directors renders the permanent establishment of a British dyestuffs industry impossible.

Indigo and Its Application

Part I

History and Description—Natural Indigo—Synthetic Indigo—Theory of Indigo Dyeing—Wool Dyeing—Fermentation Vats—Chemical Vats—Loose Wool—Yarn—Piece Goods

By PHILIP S. CLARKSON

H. A. Metz & Co., New York City

[Editor's Note: The following treatise on indigo, which will be presented to REPORTER readers in four instalments, was originally published in 1904 as a booklet, bearing the title "Indigo MLB." Since this time it has remained one of the best monographs on the subject. Being no longer available in its original form, it is reprinted here for the benefit, primarily, of the younger generation. Inasmuch as the practice of indigo dyeing has undergone little change in the past two decades, only slight revision of the original text has been necessary. Mr. Clarkson has, however, rewritten the chapter on Modified Indigos, where several new features have been developd, and has made such other amendments as seemed necessary.]

INDIGO—HISTORY AND DESCRIPTION

THE coloring matter of indigo is the one which is and has been in the past most widely known, since it was used centuries ago by the Greeks and Romans, and before that in Egypt, being found in the mummy cloths prepared at least 5,000 years ago, and the ancient Britons even stained their bodies with it. From historical accounts its use appears to have been general wherever the plant yielding this coloring principle was found.

Natural Indigo.—The method of production of indigo as we know it now was described by Marco Polo in the thirteenth century, but it was not brought from India until the sixteenth century, when the Dutch traders introduced it into Europe from the East Indies. At first these importations were not large, and the use of indigo met with great opposition on the part of the woad cultivators, and the English, French and German governments prohibited its use. Its opponents claimed that it was not only a fugitive dye, but that it was also a "corrosive and pernicious drug." In France a law was passed in the time of Henry IV which made death the penalty for using the "pernicious drug," which was also called the devil's food. The use of indigo in France was not made lawful until 1737, and the English law against it has never been repealed.[1] The most curious fact of this legislation is that the instigators of it, the woad cultivators, produced exactly the same coloring matter as that of indigo, although of inferior quality; and while from a business point of view it was good policy, in the light of the present information their stand was nothing less than absurd.

The indigo plant is a native of the tropics, and appears widely distributed, as it is found in the form of several species in India, China, Japan, Java, Central America, Brazil and parts of Africa. The most valuable species of *Indigofera* are *Indigofera tinctoria, I. disperma, I. anil* and *I. argentea.* Indigo, or more properly indigotin, may be obtained from several other species of plants besides the *Indigofera,* the most important of these being *Isatis tinctoria,* or woad, at one time extensively cultivated in England and on the Continent. Several other species of woad plant are cultivated in China for the production of indigo.

Indigo, as it is commercially known, is a mixture of various proportions of several substances; the most important and the one upon which the value depends is the indigotin, $C_{16}H_{10}N_2O_2$. The amount of this present varies from 5 to 80 per cent. It also contains 2 to 10 per cent of another coloring matter, indirubin, or indigo red. The remainder is organic and mineral matter of no practical value. The coloring matter, indigotin, as such, does not exist in the indigo plant, but in the form of its glucoside known as indican. By a long process of fermentation and oxidation this indican is split up into indigotin and indiglucin, a variety of sugar. The indigotin, with the other insoluble matter, is filtered out on cloth, pressed and cut into cubes and dried. This is the usual form in which what is known as natural indigo appears on the market.

Synthetic Indigo.—Until the last century no attention was paid to the composition of indigo. From 1865 to 1880 Dr. A. Baeyer worked out the chemical composition and several methods for the synthetical formation of indigotin; and while all the methods now employed are not entirely the discovery of Dr. Baeyer, all the credit of founding this important industry of the manufacture of indigotin should be given to him, as it is due to his untiring energy that the chemical production of this important, originally vegetable coloring matter is a possibility. Dr. Baeyer discovered three separate methods of producing indigotin which required the following chemicals as starting points: Benzoic acid, ortho-nitro-cinnamic acid,[2] and ortho-nitro-benzaldehyde.[3]

[1] Man. K. R. and L.

[2] Ber. XIII, 2259.

[3] Ber. XV, 2856.

The raw material necessary for the three methods of Dr. Baeyer is toluene. While this is one of the products of coal-tar distillation, it is not produced in sufficiently large quantities to allow its use in the manufacture of indigo in the quantity commercially necessary. In addition to this objection, the cost would be prohibitive on account of the fact that only one-half of the toluene is converted into indigotin by the chemical processes.

In 1890 Carl Heumann discovered that indigotin can be prepared from phenylglycocoll,[4] which opened a way for its production from benzene, and also that it can be produced from ortho-amido-benzoic acid.[4] At the same time a method was discovered for producing the latter from naphthalene.

In addition to these, other methods were discovered and improvements made; and while the exact processes carried out by the manufacturers are not known, the following is supposed to be one of those in use at the present time:[5]

1. Naphthalene ..... $C_{10}H_8$

to

2. Phthalic Acid ..... $C_6H_4\begin{cases}COOH\\COOH\end{cases}$

to

3. Phthalimide ..... $C_6H_4\begin{matrix}CO\\CO\end{matrix}\Big\rangle NH$

to

4. Anthranilic Acid ..... $C_6H_4\begin{cases}COOH\\NH_2\end{cases}$

to

5. Phenyl-glycinortho carboxylic Acid, $C_6H_4\begin{cases}COOH\\NHCH_2COOH\end{cases}$

to

6. Indoxyl carboxylic Acid.... $C_6H_4\begin{cases}CO\\NH\end{cases}>CHCOOH$

to

7. Indigotin ..... $C_6H_4<\begin{matrix}CO\\NH\end{matrix}>C=C<\begin{matrix}CO\\NH\end{matrix}>C_6H_4$

The two large German aniline dye works, Farbwerke, vorm. Meister, Lucius & Bruening, in Hoechst a/M, and the Badische Aniline und Soda Fabrik, in Ludwigshafen, having combined to exploit Baeyer's processes, now agreed to jointly work the processes as discovered by Heumann. Before the technical development of Heumann's method had been brought to a successful result, the Farbwerke, vorm. Meister, Lucius & Bruening, succeeded in perfecting a method for the commercial application of Baeyer's ortho-nitro-benzaldehyde process. In the laboratories of these works, a method was discovered for the production of ortho-nitro-benzaldehyde which reduced the cost of that material from $25 per pound to 25 cents per pound. The Hoechst "Farbwerke," therefore, commenced the commercial manufacture of synthetic indigo by this process in 1896, and shortly afterward the Badische Aniline und Soda Fabrik commenced the manufacture of indigo by Heumann's process. The "Societe Chemique des Usines du Rhone," in Lyons, France, having at the same time succeeded in producing ortho-nitro-benzaldehyde by a cheap and simple process, began, jointly with the Hoechst "Farbwerke," to produce indigo on a commercial scale.

While the commercial manufacture of indigo was now fully established, the most promising method, that of its production from benzene as indicated by Heumann, was still impracticable, on account of the unsatisfactory yields. A German chemist, J. Pfluger, discovered that the addition of sodium amid increased the yield sufficiently to make this process of Heumann's the most satisfactory and successful method for the synthetic production of indigo, and it is this process that now (1904) is used by the Farbwerke, vorm. Meister, Lucius & Bruening.

Indigo, the coloring matter manufactured from coal-tar products, is identical in every respect with the natural indigo and should not be in any way considered different from the latter;[6] and as the chemical composition of the synthetic product is exactly the same as that of the very purest form of the natural, which can only be obtained in the laboratory, it shows of necessity the same properties, and the only difference which exists between the two is that of appearance. The slight variations in appearance which may occur in powdered synthetic indigo are caused only by the state of division, whether coarse or fine, the product in every case being exactly the same; whereas the variations in the appearance of natural indigo are caused by the impurities present. These impurities vary, not only in the different crops of different kinds of indigo but even in single chests of the same crop from the same locality.[7] There is no basis for the claim that shades produced by the natural product are in any way different from those from the synthetic in regard to fastness to light, washing, etc.; any statements to the contrary have the same foundation of those made three centuries ago in reference to indigo as compared with woad, being due to the prejudice or business interests of the maker.

The forms in which synthetic indigo usually appears on the market are those of a 20 per cent paste and a finely ground powder. As the paste requires no grinding, this is the most common form, the powder being used for special purposes, as the manufacture of indigo extract, etc.

The manufacture of synthetic indigo has led to the production of several other interesting and useful dye-

[4] Ber. XXIII, 3043, 3431.
[5] Dic. R. G. L., p. 183.
[6] Dic. R. G. L., p. 183.
[7] M. Liebert, Year Book for Dyers and Colorists, IV, p. 365.

stuffs. These are the halogen substitution products of indigo; those derived from bromine are especially useful and produce shades that are more brilliant and in some cases faster than the pure indigo. Being of the same nature as the indigo proper, they are used in the same way and can be mixed with it if necessary.

II

Theory of Indigo Dyeing

All methods of dyeing with indigo—that is, the coloring matter of indigo—whether derived from the *Indigofera* proper, woad or other plants, or manufactured by chemical synthesis, depend upon the reduction, first, of the indigo blue $C_{10}H_{10}N_2O_2$ to indigo white $C_{16}H_{12}N_2O_2$, and, after the latter has been absorbed by the fiber, its reoxidation to indigo blue.[8] This is the only way known of utilizing the indigo coloring matter for the production of fast shades, and it has been known and used for centuries. While the basis of the various methods is the same, the methods themselves have been changed and improved with the advance of science. The oldest way of supplying nascent hydrogen necessary for the production of the indigo white is by fermentation, and this required the use of various ferments and substances capable of fermentation in combination with indigo. These substances vary greatly, and many kinds of indigo vats, as they are termed, have been in use. Most of these are things of the past, except the fermentation vats requiring the use of woad, bran, madder and syrup or molasses. The fact that woad contains active ferments probably aided the woad cultivators in their fight against indigo, as they could, on account of the natural ferments, reduce the indigotin of the woad to proper dyeing condition much more easily than that of the indigo from India, and naturally the colors produced were faster than the imperfectly dyed shades from the Indian article. All the varieties of the fermentation vats now in use may be said to date from about the middle of the last century, many improvements having been introduced and the old methods given up.

The present chemical vats are, with one exception, also a production of the last half century and, as they are in common use, will be considered in detail later.

Since the dyeing with indigo depends on its reduction and absorption by the fiber, it is evident that the aim of the dyer is to have the coloring matter in the most favorable condition for the fiber to take it up, and that it must be equally distributed in not too concentrated condition in the fiber, so that on oxidation the indigo blue will be deposited evenly in a finely divided condition. This results in the production of the brightest and fastest shades. The desired result is brought about by the proper concentration and condition of the vat, and the chances of level dyeing and fast shades may be greatly increased by giving the material several dips or runs, as the case may be.

Under ordinary conditions, the indigo white is only soluble in alkaline solution, and on this account the vat-dyeing of indigo is rendered more or less difficult, especially in the case of wool. Various means have been tried to make the operation easier and various substances have been added to the dye bath to keep the indigo white in solution without using an excess of alkali. Glue appears to be the most successful of these reagents, and the methods of dyeing based on the presence of glue in the vat have been the subject of several patents, both in Europe and the United States. The vat based on this method will be described at length.

In dyeing with natural indigo, it has been proven as far back as 1835[9] that the only substance of tinctorial value in the vat, present in natural indigo, is the blue coloring matter known as indigo blue, or indigotin, the other bodies possibly only aiding in the fermentation or being rendered useless by the process of reduction by the chemicals present in the vat. From this it is evident that the natural indigo has no practical advantage over the synthetic product as regards coloring matter, but has the positive disadvantage of lacking uniformity and the presence of large amounts of both organic or mineral impurities, which interfere with the dyeing processes and the finishing of the dyed material.

In vat dyeing an important point to be considered is the loss of indigo; that is, the actual destruction of indigotin by the reducing agents. In the vat, part of the indigo blue is not only reduced to the soluble indigo white, but also to insoluble or permanent colorless bodies. This proportion varies considerably from about 20 per cent in the soda vat to a mere fraction in the hydrosulphite vat.[10] This represents a great advantage in the latter's favor. The particular methods for the management of the different vats will be found under their respective headings.

III

Wool Dyeing with Indigo

The first and most important point to be considered is the preparation of the dye liquor according to the various methods, or vats as they are termed.

Fermentation Vats.—These vats, as before noted, were the first methods of dyeing that were ever used, and for wool dyeing they are now more extensively used than the chemical vats. The two most commonly used at present are the soda vat and the woad vat.

Soda Vat.—The soda vat is used for dyeing bright shades of blue. For a kettle of 900 gallons the following proportions are used:

[8] Hummel, p. 295.

[9] Schwarzenberger & Schwartz, Bull. Soc. Industrielle de Mulhouse X, 413, 425.

[10] Binz & Rung, Zeit. fur Ang. Chemie, 1898, No. 42.

6 pounds Madder.
6 pounds Syrup.
16 pounds Wheat Bran.
16 to 30 pounds Carbonate of Soda.
10 to 15 pounds Indigo 20 per cent paste, or
2 to 3 pounds Indigo powder.

If the indigo powder is used it must be ground with water the same as the natural product. The vat is filled with water and the materials added as convenient, and while stirring thoroughly the whole is warmed to 127 deg. Fahr. The vat is covered and allowed to rest for the day. On the second day it is again heated to the same temperature and stirred. This is repeated on the next and following days until the fermentation has completely reduced the indigo. The fermentation often starts as early as the second day. When the indigo is reduced, it will be apparent by the color of the liquor having changed from a dull black color to a bright yellow. Should the proper conditions not appear on the fourth day, the fermentation may be hastened by hanging in it a sack of bran, which will usually produce the desired effect. After the indigo has been completely reduced the fermentation should be modified by the addition of lime. Small quantities of lime are added, and after each addition the vat is thoroughly stirred. When in proper condition the liquor has a clear yellow color and is covered by coppery scum or flurry. The addition of lime regulates the fermentation and supplies the vat with alkali, which is required to keep in solution the indigo white produced. If too large a quantity is added at one time it will stop the fermentation altogether; and if too little, the acids which are generated by the ferments are only partly neutralized, and part of the coloring matter of the indigo is lost. When the vat has the proper appearance, a dye test may be made with a small portion of wool, and if the result is satisfactory the vat may be used for dyeing.

After this, for two or three days, 10 to 12 pounds indigo paste, or an equivalent proportion of powder, with the necessary materials, are added to the vat, and only one or two lots of wool dyed daily until the vat is in proper condition for continuous dyeing.

Woad Vat.—This kind of vat is principally used for dyeing dark blue shades. For a kettle of 900 gallons the following proportions are used:

60 pounds Woad.
10 pounds Madder.
20 pounds Soda cryst.
12 pounds Syrup.
20 pounds Wheat Bran.
30 pounds Indigo 20 per cent paste, or
5 to 6 pounds Indigo powder.

If the latter is used it should be ground with water. This vat differs from the former in the addition of woad and the fact that it should be heated to higher temperature. The material are added to the vat and heated to 160 to 165 deg. Fahr., and the fermentation should take place in a similar manner to that of the soda vat as described above, and the sharpening with lime is carried out in the same way. In both of these vats local conditions regulate the amount of lime necessary. In some cases only a small quantity is used, and others as much as 5 to 6 pounds may be required.

The proper condition of a vat can only be known by practical experience, and the dyer's attention must be especially directed to proper sharpening of his vat before he can be certain of successful results.

Chemical Vats.—For wool dyeing the use of chemical vats up to the present time has been limited. While some forms have been in use for some time, the comparatively recent hydrosulphite vat is the only one of importance. In this vat the reducing agent is sodium hydrosulphite ($Na_2S_2O_4$), which is prepared by the action of zinc dust on sodium bisulphite. This can be done by the dyer, or use can be made of commercial hydrosulphite, which is more convenient. The proper way of starting this vat is to prepare a stock liquor by making a concentrated indigo solution and adding this as required to the dye kettle. For preparing this stock vat use:

10 pounds Indigo powder or
50 pounds Indigo 20% paste mixed with
2½ gallons Warm Water and
3¾ gallons Caustic Soda 76 deg. Tw.

and stirred well together and heated to 105 deg. Fahr. Then 8 gallons hydrosulphite are added and the temperature is kept at 100 to 105 degrees for one to two hours. If at the end of this time the indigo is not reduced perfectly more hydrosulphite is added until the solution is a clear yellow.

The dye bath is prepared by adding a small quantity (about 1 quart) of hydrosulphite for each 500 gallons of water. It is then well stirred and covered, and allowed to stand for a few hours. The necessary amount of stock liquor is then added and the whole stirred and allowed to stand for several hours, when it is ready for dyeing.

Handling of Material

For the proper working of the material to be dyed, various mechanical appliances are necessary. Loose wool is usually suspended in a net in the vat liquor, and after the requisite time of immersion the net is wound up on a pole on the top of a kettle, thus saving the excess of liquor which drains into the vat. Warps are dyed in chains which run through the vat liquor on frames which are portable so they may be transferred from one vat to another. In piece dyeing use is made of hawking machines for handling the goods.

These methods for the application of the indigo coloring matter are more or less intricate and therefore require the most skillful management and care in handling in order to prevent unevenness in the shade and loss of color. As an improvement on these, the Farbwerke vorm. Meister, Lucius & Bruening have brought out a preparation which is known as Indigo Vat MLB to obtain certain results with practically no loss of color. (This form of indigo is now generally available.)

Methods of Using Indigo Vat

Preparation of the Dye Vat.—The dye tub of about 750 gallons capacity for dyeing should be preferably of wood and should be filled with warm water, heated to 120 to 130 deg. Fahr., and from 1 to 2 quarts of ammonia are added until a slight alkaline reaction is observed. Then the following are added:

2 pounds Glue dissolved in
2½ gallons Water,
2½ to 2¾ gallons Hydrosulphite and
2½ to 5 gallons Indigo Vat.

The quantity of indigo vat to be used is, of course, regulated by the depth of shade required. When the vat is in proper condition, the liquor must have a greenish-yellow apearance, and a dyed sample should turn green easily when exposed to air; a pure yellow solution is the sign of too much alkali or hydrosulphite; a pure green shows that there is too little.

Dyeing of Loose Wool.—After the vat is prepared it is stirred a few times and the wool, which has been previously wet out, is entered. The wool should be worked for fifteen to twenty minutes under the surface of the dye bath, taken out and squeezed. It is better if the kettle is arranged with a squeeze which allows the waste liquor to run back in the vat. The rollers should be as near the liquor as possible. The wool is then exposed in the air and given a second run in the vat without the addition of any more indigo, and again worked for the same time, squeezed out and exposed. It will be found that the wool absorbs much more indigo on the second run, so that most shades will not require more than two runs for their production.

In dyeing very dark shades of blue, 1 or 2 quarts of bisulphite diluted in water should be slowly added to the dye kettle while the wool is being worked. This has the effect of producing in the vat, which was alkaline at first, a slightly acid reaction. The result of this treatment is that the wool absorbs the greater part of the indigo in the vat (about 80 per cent). In this way loose wool may be dyed a dark blue in one dip, the shade being regulated by the amount of indigo added. Loose wool, however, being not very clean, it is recommended that it should be dyed in two dips, as the color will come out more level. After the addition of the bisulphite, the proper acidity of the liquor can be recognized by the addition of one to two drops of phenolphthalein solution to a tumbler of the vat liquor. This should give no red color. After a lot of wool is dyed the vat can be used again but must be neutralized by the addition of ammonia until a slight alkaline reaction is shown. The phenolphthalein solution is used as above, but in this case should give a faint red color which should soon disappear. If it remains permanent, too much ammonia has been added. After neutralizing, the required amounts of indigo vat, hydrosulphite and glue are added and the operation continued as before.

The wool should be taken out of the kettle and squeezed as quickly as possible so that it will not oxidize with an excess of liquor in it. After it has been run through the squeeze, it is allowed to lie in piles until thoroughly oxidized. Two dips are usually sufficient for even the darkest shades. The relative proportions of indigo vat, hydrosulphite and ammonia necessary for the production of the different shades and the appearance and reaction of the vat are shown by the following table:

Shade	Indigo Vat	Hydrosulphite	Ammonia
Dark	Much	Little	None
Medium	Equal	Equal	Little
Light	Little	Much	Much

Shade	Appearance of Liquor	Reaction with Phenolphthalein
Dark	Dark Green	Trace Alkaline
Medium	Green	Slightly Alkaline
Light	Yellow Green	Alkaline

Shade	Indigo Vat	Hydrosulphite	Ammonia
Dark	2¾ gallons	1¾ gallons	....
Medium	1¼ gallons	1¼ gallons	1 pint
Light	1-2 pints	1 gallon	3 pints

The same quantity of glue is used for all shades.

The above is an example of average proportions, which can be varied to suit the particular conditions. The appearance and reaction of the liquor must be carefully observed in judging the proper condition of the vat. The alkalinity is determined by a drop or two of alcoholic phenolphthalein in a test tube full of the vat liquor. The stronger the red spot formed the stronger the alkalinity of the vat. When but weakly alkaline, the red is very weak and disappears almost immediately, and if the vat is acid no color will be shown.

The further operation of the hydrosulphite vat is carried out in the same way as the setting. The amount of indigo vat naturally depends on the shade desired; for dark shades an addition of about one-half, and lighter shades in proportion, down to one-quarter of

the amount originally added. After dyeing three or four lots, it will be found that a constant quantity may be used and the shades produced practically without variation. As a coarse wool will exhaust better than a fine wool, the amount of indigo vat to be added will naturally be greater in the former case, as with a fine wool more remains in the bath.

The addition of hydrosulphite is about one-half to two-thirds of the first amount without regard to shade. If the vat stands for some time without being used, more hydrosulphite will be necessary than with constant running, and in this case it is advisable to add some hydrosulphite and ammonia at the end of the run, so that the oxidation of the indigo while the vat is out of use will be stopped, and when the dyeing is commenced a less amount of hydrosulphite is necessary. In adding the hydrosulphite and indigo vat the best plan is to mix them together and add water at a temperature of about 160 deg. Fahr.

The amount of ammonia depends on the shade desired and should be regulated by the phenolphthalein test as shown above. Indigo dyes more equally and slowly in the alkaline bath, and therefore the lighter the shade the more ammonia will be required. Dark shades can be dyed without ammonia, and as a rule cannot be obtained in an alkaline vat. While the addition of ammonia is not advisable in starting a vat for dark shades, it may be necessary to add some if the vat has been used for some time, as the decomposition of the hydrosulphite produces an acid reaction.

The addition of glue is regulated by the length of time the vat is run. If the vat is renewed weekly the quantity added on starting the vat is sufficient, but in case of longer runs, at the interval of a week, from 1 to 2½ gallons of glue solution should be added.

As a rule, after dyeing in the hydrosulphite vat the wool is squeezed out, causing the dirt to be retained in the liquor. Therefore, the vat should be renewed more frequently than the fermentation vat. There is no loss in this renewal, as the coloring matter can be exhausted by running through several lots of wool without further addition of indigo. Practice has shown that after 3,000 to 4,000 pounds of wool has been dyed in a vat with a capacity of about 750 gallons, the liquor becomes too dirty for further use and the vat should be reset. As this quantity can be dyed easily in a week, it is advisable to exhaust the vat on Saturday and start a fresh one on Monday.

Dyeing of Yarn.—The difference between dyeing of yarn in an open kettle and loose wool is only in the manner of handling. A sufficiently deep yarn kettle is used, and the yarn may be hung on cords or on bent iron rods and worked under the surface of the liquor. The condition of the vat is maintained and the proportions are the same as for loose wool. After dyeing, the skeins are run separately through the queezer, and in the case of light shades run through cold water, and for medium and dark shades allowed to oxidize in bundles.

Machine Dyeing.—Indigo vat can be used in several forms of apparatus, the principal requirement being that the liquor during the circulation is not exposed to the air. Any kind of loose material, as slubbing, yarn, etc., can be dyed in this way. The vat is prepared as for loose wool and the material is packed in closely. On account of this method of handling it is best to produce the desired shade in one dip. The method is as follows:

After the vat is properly prepared, as noted above, for wool, the circulating apparatus is started and the liquor forced through the material. After five to ten minutes' run some dilute sodium bisulphite is added, preferably through the feeding funnel, until the dye bath has a slightly acid reaction, which can be noted by a phenolphthalein test. In this way the wool can be made to absorb about 80 per cent of the indigo in solution in the vat. The circulation is kept up until this has taken place, and as a rule it will require about 1 to 2 quarts of bisulphite and twenty to thirty minutes' time to dye the shade.

The dyed material is oxidized as rapidly as possible, and this effect can be produced most easily by circulating through the machine a large quantity of fresh water.

The amount of bisulphite depends upon the conditions of working and can be judged best by experience, but as a rule the above quantity will be sufficient for each 100 pounds of material. After each lot the vat can be used again, but must be neutralized by the addition of ammonia, as noted in the case of loose wool. For very light shades, ordinarily known as "pearls," the addition of bisulphite is unnecessary. As a rule, in machine dyeing a greater proportion of hydrosulphite is necessary than with the open kettle.

Piece Goods.—For dyeing piece goods in the vat, to produce good results a wringer and hawking machine are necessary. In hawking the goods by hand, as was formerly the practice, many faults, as hawking stains, air marks or other unevenness, were caused, all of which can be avoided by the use of the machine, by which the goods are moved under the vat liquor over rubber rollers.

Before dyeing, the goods must be thoroughly wet out in the washing machine and extracted. After this they should be entered in the dye vat and worked constantly for one and one-half to two and one-half hours; the length of the time depends on the shade required and the quality of goods. Naturally, heavy goods require a longer time for thorough penetration than lighter material. Piece goods require, further, a larger proportion of alkali than loose wool or yarn. After dyeing, care should be taken that the goods are squeezed out evenly at full width through proper squeeze rollers, as noted in the case of yarn. From the squeeze rollers they should be spread out to oxi-

dize, during which they should be covered by a cloth. This keeps them warm during the process of oxidation, which materially aids in the production of bright shades. Hanging the goods in the air upon bars will not result in as brilliant shades, but in cases where the vat liquor has not been evenly squeezed out this will be necessary to remedy the defects. As in the case of yarn and piece goods, two dips are usually given, and for very dark shades bisulphite is used.

If the goods must remain a long time between dips, or before they can be washed, it is advisable to pass them through warm water, and it is to be noted that in the case of the hydrosulphite, as in the fermentation vats, the vat room should be kept warm.

The advantages of indigo vat over fermentation vats and the ordinary hydrosulphite vats may be stated as follows:

Advantage Over Fermentation Vats.—Wools used for the manufacture of cloth are rarely clean when given the ordinary scouring for dyeing and contain more or less wool grease and other matters. This, in the case of vats where lime is used, may cause the fermentation of lime soap, which hinders the carding and other operations of spinning. This may also be a cause of difficulty after the goods are woven and interfere somewhat with the fulling and other finishing operations. With the use of indigo vat, which contains no lime, these chances are entirely avoided, as the formation of lime soap is impossible. It is also to be noted that the shades in fulling and scouring will lose less color than those dyed in the fermentation vat. The absence of all sediment in the vat is also a great advantage, and also the ease and quickness with which it may be operated, being nearly as easily managed as ordinary acid dyeing. With moderate care and attention, uniform shades, which are much faster to rubbing than the average indigo blue, can be readily obtained in any dyehouse.

Advantage Over the Ordinary Hydrosulphite Vat.—The objection to the hydrosulphite vat for wool dyeing has been, owing to the large proportion of alkali present, the tendency to injure the wool fiber, but this is impossible with the use of indigo vat, which is made only slightly alkaline with ammonia at first, and during the process is altered to a slightly acid reaction. This naturally cannot injure in any way the strength of the fiber. Further, after dyeing the wool is cleaner and more open than before, and the waste in carding is lessened. Light tips in loose wool are absolutely prevented, even in badly scoured wool. A further, and probably the greatest, advantage is that dark shades can be obtained in one dip, whereas with the ordinary hydrosulphite vat it is difficult to obtain a very dark shade with several dips. This necessarily avoids much handling of the wool, and thus saves labor and expense. All these show that it is possible by the use of indigo vat to obtain more brilliant shades at a much less cost than by any ordinary methods.

Combination Dyeing with Indigo

For a long time it has been the custom to make combination shades such as brown, olive, etc., using indigo for the necessary blue color. This was done either by dyeing the material first with indigo, then dyeing the other color on top, or by dyeing a suitable color and then overdyeing this in the indigo vat. The after-chroming colors, such as acid alizarines, chromotropes, etc., are very suitable for this purpose, either as a bottom for indigo or for topping indigo bottoms. For indigo bottoms, it is recommended to use the indigo vat. The blue bottoms dyed in this way will be found to be faster and lose less in the overdyeing than when dyed in the fermentation vats.

Very satisfactory shades can be obtained by the use of Acid Alizarine Gray G, Alizarine IWS, Alizarine SBW powder, Acid Alizarine Brown B or BB, and Mordant Yellow on various shades of indigo bottom, especially when these after-chroming colors are developed by the lactic acid method. In some cases it is also possible to shade the blues with fast acid colors, such as Acid Rosamine A, Fast Acid Blue R, and the Fast Acid Violets. Neutral Violet O can also be used in the neutral bath for brightening dark shades of vat blue. For a long time for making heavy navy blue it has been customary to put on a bottom of about 2 per cent of 20 per cent alizarine paste dyed on a chrome mordant, then top this in the indigo vat. Besides this, it is possible to use alizarine colors, such as Alizarine Red IWS, etc., dye these in the acid bath and develop with fluoride of chrome. The material is then rinsed and topped in the indigo vat as usual. Two dips with the improved hydrosulphite vat will usually be sufficient.

(End of Part I. Part II will follow in next issue)

OUR TRADE WITH JAPAN

Has Shown Enormous Gains in Recent Years—Big Increase in the Percentage We Hold in the Trade of Japan

Trade of the United States with Japan totaled 585 million dollars in the fiscal year 1923 against 149 million dollars in 1913, 65 million in 1903 and 30 million in 1893. That the trade with our neighbor across the Pacific has far outgrown that with other parts of the world is evidenced by the fact that the 1923 trade with Japan is 19 times as much as in 1893, 30 years earlier, while our total foreign trade in 1923 was only five times as much as in 1893.

It was about the year 1893, says the Trade Record of the National City Bank of New York, that our export trade to Japan began to show a remarkable growth. Our total exports to that country in 1893 were but $3,195,000, jumping to 21 million dollars in 1903, 57 million in 1913 and 213 million in 1923, all of these being fiscal year figures. The imports from Japan also show big gains, but not in as large proportion as that of the exports, the

total imports from that country having advanced from $27,454,000 in 1893 to 44 million dollars in 1903, 92 million in 1913 and 373 million in 1923. The 1923 total is, in both imports and exports, about four times as much as in 1913.

Japan's own trade figures show not only large gains in her trade with United States, but that the percentage of her trade which she draws from and sends to this country has steadily increased. In 1913, the year before the war, her takings from the United States formed 17 per cent of her total imports and in 1921 they were 31 per cent of her imports. In 1913 her shipments to United States formed 29 per cent of her total exports and 1922 over 40 per cent.

Raw cotton, iron and steel manufactures, automobiles, electrical apparatus and machinery, mineral oils, tobacco and lumber form our chief exports to Japan, and raw silk, tea, rice, vegetable oils, furs and silk goods form our chief imports from Japan.

PRINCIPAL EXPORTS FROM UNITED STATES TO JAPAN, FISCAL YEAR, 1923

Cotton, raw	$87,459,000
Wheat	6,595,000
Illuminating oil	4,230,000
Rails for R. R.	3,135,000
Tin plate	3,165,000
Sulphate of Ammonia	6,079,000
Flour	1,365,000
Lubricating oil	2,948,000
Gasoline	1,484,000
Gas and fuel oil	1,296,000
Steel sheets	2,811,000

Sizing*

Materials Employed—Mixing—Ball Sizing and Slashing—Great Care Essential to Uniform Results —Pumps and Piping

By W. H. WHEWELL

THE sizing of cotton goods, as now practised, is one of the most unscientific processes with which the manufacturer has to deal.

In the process of weaving, the wear and tear on the warp by the pulling action of the healds on the one hand and the wearing action of the shuttle passing across the threads, on the other, is much greater than in the case of the weft, and sizing is introduced with the view of increasing the strength of the warp. The process of sizing is very old, since the ancient Oriental nations dressed their warps with rice water. The method first adopted in Lancashire was simply to pass the threads of warp through some adhesive matter such as flour paste, when, on drying, the extra strength required for the warp to pass through the loom was obtained; but a harsh feel was imparted to the cloth. Later, tallow or oil was added to the flour or starch paste, to give the desired softness, and this mixture is quite satisfactory as regards the manufacture of the fabric. But it was found that some kinds of size and modes of mixing made the woven fabric appear fuller and better, and thus there was and is ample scope for the skill and ingenuity of the sizer.

The problems which the manufacturer must solve are rather complicated. First, he must produce gray cloth of specified pattern and of a certain length, width and weight. Then the cloth must possess an appearance and handle equal to some standard.

Sometimes the problem is to make gray cloths of specified dimensions, weight and appearance, with as little cotton as possible. The remainder of the weight, feel and general appearance of the fabric must then be supplied by the size, which under these conditions is usually a complicated compound.

Sizing materials may be divider into four classes, namely:

1. *Substances Giving Adhesive Properties to the Size.*—Wheaten flour, sago, maize and rice starches, farina, soluble starch.

2. *Materials Used to Give Weight and Body to the Size and Yarn.*—China clay, magnesium sulphate or chloride.

3. *Oily or Greasy Matters used for Softening the Size and Yarn.*—Tallow, olive oil, glycerine, paraffin, Japan wax.

4. *Antiseptics.*—Chloride of zinc, carbolic acid, formaldehyde.

In regard to the application of the size, the slasher has several advantages over the ball sizer, while on the other hand the advantages of ball sizing over slashing are mainly restricted to considerations of weighting. Slashing in conjunction with the self-stopping beaming machine is a very finished operation in contrast with the clumsy business of ball sizing and the expensive beaming necessitated by it; but for certain classes of goods ball sizing is quite indispensable. Whenever a "pure" cloth is required, however, the superiority of the slashing machine is very apparent.

In the preparation of the mixing, the importance of careful weighing and measuring is not sufficiently recognized. Some imagine that a little more or less of this or that ingredient cannot make much difference in a large mixing, but this is quite wrong, for there is hardly any operation where correct and careful weighing and measuring is of greater importance.

With regard to the nature of the "mixing," everything

*A paper read before the Midlands section of the Society of Dyers & Colourists, and published in the Journal of the Society.

depends on the class of work. For a "pure" cloth or for printing cloths, nothing more is required than flour or starch, and tallow. For printing cloths, chloride of zinc is not only unnecessary but would interfere with the operations of the printer.

The quality of the ingredients used in sizing is not sufficiently taken into account, and consideration is often only given to the price. This is not true economy.

The methods practised by sizers are very variable, this being due to the absence of a reasonable system based upon a simple investigation of what will best fulfill the object in view. Such a system, of course, involves a knowledge of the properties of the different substances used.

In some otherwise modern works the process of sizing is still carried out in a very crude manner, and chemical substances and secret preparations are added to the size without any good reason. In the sizing of cloth intended for bleaching and dyeing, particular care should be taken in the selection of the sizing materials.

Much trouble to the bleacher and dyer is caused by magnesium chloride, zinc chloride and paraffin wax. Magnesium chloride is a valuable addition in sizing yarn, as it is hygroscopic, and keeps the yarn in good condition for the weaver, who has less breakages and consequently a greater production. It is, however, a most dangerous substance in cloths that require to be singed. Zinc chloride is often added to sizing materials to prevent mildew. It should be replaced by formaldehyde whenever cloth is to be singed to avoid the same trouble as when using magnesium chloride. Whenever zinc or magnesium chloride is used in sizing, its presence should be declared by the manufacturer and the goods could then be washed before singeing, or the singeing process should be omitted altogether. Paraffin wax is unsaponifiable, and is difficult to remove during bleaching.

Relatively few mills realize the lack of uniformity which attends the sizing process. Under the conditions imposed by the incompleteness of the average sizing equipment, uniformly good results are impossible.

Suitable equipment, great cleanliness and careful control are absolutely essential to the production of uniform work. The size house should be as clean as a kitchen, as preparing size uniformly, so far from being a crude operation, requires great cleanliness and careful attention to details. Considering how easily the consistency of starch, either in its manufacture or in its use, is affected by slight chemical or bacterial action, the degree of cleanliness usually exercised in the cistern room is insufficient. Any size left in the cisterns will affect a subsequent mixing. Cisterns and agitators need frequent scraping, flushing and cleansing to ensure uniform results in the sizing process.

The dry starch should be stirred into water and strained through a sieve on its way to the boiling cistern. The breakage of threads on the slasher due to the presence of chips, insoluble lumps and other foreign matter is thus avoided.

Rust spots and stains are generally due to insufficient cleaning of the cistern or its fittings. The chemical action of caked and putrifying size on a susceptible metal is rapid. Iron cisterns are a costly economy. Tinned or galvanized iron is better, but copper is the best.

Wood is largely used for cisterns. The shape of the cistern is usually wrong, the corners of the wooden cisterns making proper agitation impossible. Unless wooden cisterns are frequently renewed, the wood becomes impregnated with bacteria, which exert a thinning action on the mixings. Cisterns ought to be fitted with tight covers, as the difference in viscosity of the mixtures due to condensation or evaporation is appreciable, and may be sufficient to affect the weaving quality of a warp.

All cisterns ought to be fitted with efficient agitators. The usual two-paddle one-way agitator is defective, as it revolves the size instead of thoroughly mixing it, with the result that the starch paste is not homogeneous, but contains globules or lumps of starch. Sets of agitator arms moving in opposite directions give a mixture of uniform consistency, break up the lumps, bring every part of the mixture into contact with the maximum heat, and lessen the accumulation of cakes of size on any part of the cistern or agitator arms.

The method of heating the mixture in the cistern is important as regards the uniformity of the results. Small jacketed cisterns constitute the only satisfactory arrangement for small plants.

Many mills have plenty of cisterns and plenty of slashers but defective pipe connections. A small outlay for extra piping and valves, to connect every cistern with every slasher, would allow of any kind of mixing desired to be run on to any slasher. The piping ought to be of copper or brass, and of ample size. Iron piping means a run of rust spots at some time or other.

It is practically impossible to size uniformly with a gravity system of conveyance from cisterns to size boxes. In any gravity system, the size has time to cool and gelatanize in some selection of the piping. If this cold size sticks and has to be blown out by steam, the result is a run of thinned size and before the jelly lumps that blow out can be boiled up, they are likely to form hard spots on the yarn. A pumping system avoids these troubles. No pumping system, however, is complete unless the piping admits of constant circulation of the size from the cisterns through the pipes past the tap of each slasher and back again to the cisterns. Then the size is delivered at a uniform heat and viscosity. If a long curve dip is given to the main pipes beside each box, all possibility of disturbance from cold size in the short branch pipe can be avoided.

A useful arrangement of piping found in a few mills is one in which all size left in the size boxes at night can be pumped back to the cisterns, leaving the boxes empty to be flushed and cleaned, but in many mills no such arrangement is available, and the size is left in the boxes overnight. It would be a saving in weaving expense to

throw this size away, as the skin that forms in contact with the air is useless. With a complete circulation and pumping arrangement for the whole piping system, the boxes and the cisterns can be flushed with hot water and steam, and cleaning made part of the routine operation of the sizing plant.

Size that is boiled up a second time is not as efficient as freshly prepared size. Re-boiling impairs the adhesiveness, a fact that doubtless explains the feeling of some operatives, that letting size stand overnight makes it smoother in feel in the morning. Where size must be left overnight, mixing it in the morning with a freshly prepared and heavier mixing is the best expedient.

An important factor in uniform sizing is the height of the size in the box relative to the squeezing rollers. Regulation of this is generally left to the vigilance of the slasher attendant, but there should be an automatic float-feed which keeps the size at a practically constant level. In mills where there are no such devices, the size gets low in the box, and it is the custom to keep lowering the immersion roller instead of constantly running in more size. But it is not merely the depth of the immersion roller in the size that determines the amount of size taken up by the yarn, but also the dip of the squeezing rollers into the size.

The weight and condition of the squeezing rollers also greatly influence the amount of size taken up by the yarn and the degree of penetration. Too careful attention to the condition and lapping of the cloth on the rollers cannot be given, steaks and badly sized spots readily being caused by poor lapping.

The usual cylinder drying slasher has defects that have led to the adoption in France, and to some extent in England, of improved forms of air drying apparatus, utilizing modern principles of forced ventilation; and these developments are worthy of close investigation. Briefly, the new system is said to give greater production, dry the yarn progressively, reduce the tension to a minimum, retain the original roundness of the thread, largely do away with the defect of baking the ends, automatically cool the drying chambers during stoppages, and better the room conditions.

The substitution of air for cylinder drying is an important factor in assisting uniform work. It is extremely difficult to regulate the heat on cylinder dryers. Stoppages or slow runs generally mean hard and streaky sized places when cylinders are used, entailing damage to the threads when they are pulled apart at the lease rods, difficulty in the loom and an uneven feel in the cloth. The use of automatic appliances to reduce the steam heat in the cylinders is a help, but even then the heat retained by the metal surfaces of the cylinders tends to bake the yarn. In the new drying machines, quick cooling of the drying chambers during stoppages is easily effected.

New products should be tried only after a chemical test has shown some probability of their usefulness. Many a manager has trusted to the supposed infallibility of a practical test in the mill, whereas a sizing test is infallible only if it is a very painstaking detailed test; which is seldom the case.

With proper equipment, known materials, and tests that really give the necessary information, the sizing process can be put on as exact and dependable a basis as any other process in textile manufacture.

Dyeing Astrachan Fabrics

Methods Followed in Handling Different Grades of Cloth and for Various Effects

WHEN astrachan cloth is delivered to the buyer, the first operation is to cleanse it of all oil and dirt. This operation is almost identical with ordinary cloth scouring, and requires the same amount of care. The scour bath is made up with a sufficient quantity of soap to maintain a mild lather, and the temperature should be as low as possible, since any excess of heat (never use above 120 deg. Fahr.) is likely to cause a loss of some of the curl in the pile, and also to favor felting, which would cause a deadening of the general appearance.

Where soft water is available, only soap need be used in the scours, but where there is an appreciable hardness a little ammonia will be found to work advantageously in addition to the soap. Distinctly hard water is not suitable for this work. After the pieces are cleaned, they are to be washed well, when they are ready for dyeing.

Two general methods for dyeing these goods are employed. The first and most important is with the direct colors that dye both the cotton and wool in one operation and approximately the same shade. Certain combinations of such dye may be made which include in their composition a small amount of neutral dyeing wool dye for the purpose of imparting clearness or brightness to the wool portion of the cloth.

Such a mixture of dyes, when used in a "short bath" and with a relatively small amount of Glauber salt, will produce very even shades on both the mohair and cotton, while at the same time preserving the luster of the former. It should be remembered that in dyeing fabrics composed of both mohair and cotton, the dyer must always protect the luster, and Glauber salt therefore becomes necessary. Common salt is not desirable. The amount of Glauber salt used varies from 5 to 7⅜ pounds for each 25 gallons of dye bath.

Heavy shades are dyed by charging the bath with a suitable amount of dye and Glauber salt, boiling for a few minutes, shutting off the steam, and then entering the pieces without further heating, and allowing them to

run for about three-quarters of an hour. Afterward the kettle is brought to the boil and boiling continued for one-half to one hour, or until a swatch shows that the proper depth of shade is obtained on both the mohair and cotton. As a rule, it is not absolutely necessary that the back and pile should exactly match, but the pile should match the standard sample. It is always an advantage in dyeing these goods to have the cotton back come up much darker than the pile.

Cross-Dyeing

Much astrachan of the better quality is made with cotton previously dyed with sulphur colors, woven with curled mohair yarn, the pile being afterward dyed with suitable acid colors. This is the well-known cross-dye method. Since the sulphur dyes resist cross-dyeing, their use enables the dyer to concentrate his efforts on the pile. For this purpose the acid dyes are most important, from the fact that the brilliancy of shade and luster of the wool or mohair is preserved. This method of manufacturing has the advantage that where the cotton back is dyed black, the pile may be dyed any dark shade, such as brown, green, blue, etc., to the greatest advantage. Some mills always use black cotton for their dark shades, while others use darker shades of the same color for the back than for the pile; the result is about the same in either case.

Formerly astrachans were dyed in ordinary open kettles by working over a winch, but now they are dyed in cloth-dyeing kettles of the improved types, much in the same way as other union goods are dyed.

Light Shades

In dyeing light shades, the main point is to add the previously dissolved dyestuff in successive portions and to cut swatches at frequent intervals as the final shade is reached. Unless preliminary trials have been made to determine the quantities of dye to make the match, the dyer will have to be watchful, otherwise the shade is likely to be too heavy.

Full Shades

For full shades, browns, greens, blues, etc., after the quantities of dyes have been established by tests or previous runs, the total amount of dye can be added to the bath in two portions. In case of blacks, the dye can be added at once, and gradually increase the temperature of the bath to the boil. Regarding blacks on this material, the richest and fullest blacks are still to be obtained by the use of logwood upon a chrome and tartar bottom. This is the method long since in vogue for the best makes of such goods from England and the Continent.

Logwood shaded with a little fustic, when well dyed, seems to yield a black with a bloom that has not yet been duplicated by any of the coal-tar dyes. For this reason logwood is used for the higher qualities of this fabric. Another characteristic of logwood for this purpose is the increased fullness and weight it imparts to the wool or mohair; attempts to equal this feature with some of the coal-tar dyes by using them in combination with logwood form the basis of several patents.

Much fancy dyed astrachan on the market has every appearance of not having been given all the attention that it deserves during the wet processing. While opinions may differ slightly about some of the details of dyeing and finishing, perhaps with no other class of fabrics do these two operations come closer together. If the finishing has not been properly done, the natural luster of the wool or mohair used does not show up to the best advantage, and in goods of this class luster is most important. Dull, lifeless pile, no matter how well woven or dyed, is a positive injury to the attractiveness of the cloth and greatly impairs its selling qualities.

Stock and Yarn Dyed

With bright shades, the necessity for bringing up the luster is as essential as for the so-called "naturals" and "blacks." With these two latter, however, the greatest care is usually taken. "Naturals" are made by combining black dyed mohair with a proper amount of white or undyed mohair, and then making the yarn from the mix. Other "naturals" are made by twisting black and white yarn together. In either case the characteristic natural gray apears in the finished goods. It is needless to observe that the black dye used must stand the scouring and the final lustering operations.

Finishing Emulsion

The peculiar luster on the better quality of these goods is the result of applying to the pile of the dyed goods a thickened emulsion of cocoanut oil, or other similar oil, with starch and perhaps dextrine. Afterward the cloth is subjected to a light steaming, which causes the wool or mohair to take up the oil and retain it. The cloth is then washed with water to remove all excess of starch, etc., and finally run in a wash with fuller's earth. It is this latter that imparts the peculiar softness to the mohair pile that cannot be secured in any other way.

In dyeing mohair, it is found to work somewhat differently in the bath; it takes up dye less readily than wool, consequently a longer time should be given, although actual boiling of the bath may not be necessary. Keep the Glauber salt down to the lowest amount consistent with level dyeing, and use a small quantity of acetic acid to assist the color in going on the fiber.

Astrachans, though closely related to mohair plushes, may be handled in the dye kettle with greater freedom; they may be dyed in strings, while plushes must always be handled at full width. The dyeing conditions, however, are about the same for each class of goods.—Textile World.

Finishing Soft-Handling Woolens

A FINISHER recently recommended boiling cloth with fuller's earth, either after milling, scouring or gigging, as an excellent means of satisfying oneself of its state of purity. The piece of cloth for this purpose is wrapped wet on a perforated roller, and immersed for three to four hours in water at a temperature of 190 to 212 deg. Fahr. It is then unrolled while still hot, and entered at once in the scouring machine, in which it is rinsed for forty-five to sixty minutes with a dilute solution of fuller's earth. All the soluble impurities in the cloth, as well as the mucilaginous substances adhering to the wool fiber itself, and tending to make it more or less hard, are thoroughly removed by this process, and a very soft and agreeable feel is in turn imparted to the cloth.

A machine constructed for carrying on this process consists of a vat filled with boiling water, through which the cloth is repeatedly drawn slowly to and fro by a series of carrying rollers. In the center of the vat, and above the water level, are a pair of squeeze rollers, underneath which is a trough for carrying off the impurities squeezed out of the cloth.

Another Method

The same results, however, are accomplished by steaming the goods while wrapped on perforated copper rollers, after being passed through boiling water. The steam at first enters into the interior of the roller, from thence to the small holes in the side and through the cloth, drawing out the water and the dissolved impurities, especially if the process follows gigging, which frees the cloth of many otherwise insoluble substances.

Any soft handle on cloth not gigged is due to the natural softness of wool fiber, the process of napping of gigging being a means of increasing this handle, although not to the extent that is generally supposed. A fabric that is naturally hard, either on account of the material hardness of the wool or as a result of the subsequent unsuitable treatment, can be only very slightly improved by napping or gigging, for the reason that the hard character of the fabric will not entirely disappear even with any amount of gigging or napping, since either procedure can only increase the softness of the cloth by loosening its felt, the process in itself not influencing the nature and character of the wool.

To Avoid Tender Fabrics

It must be borne in mind that any considerable amount of napping or gigging will make the fabric tender, and the demand for medium woolens is for a strong, durable fabric, hence gigging or napping cannot be overcome by trying in this way to impart or increase, as the case may be, the softness of the fabric. Not infrequently a finisher may cut down the amount of gigging actually necessary to give a fabric the finish required, solely to avoid producing a tender fabric, knowing that a few more turns on the gig would result in such a condition; in other words, he has to sacrifice the finish to strength, the latter being more important.

Points which may assist the finisher in imparting a soft feel to a fabric are: Never permit wet cloth to remain too long after being milled and scoured; napping or gigging, as the case may be, should be proceeded with as soon as possible, because woolen cloth becomes hard if it is allowed to lie in a wet or moist condition for any length of time. The nature of the wool, as well as the condition of the water, is also a factor to be taken into account, hard water tending to make the cloth harder and stiffer.

When starting the gigging, do not have the cloth too wet, using at the same time, first, a dull set of teasles so as to assist in loosening the nap. If gigging is carried on in too wet a state the teasles will pass over the surface of the cloth without effect, and in place of a full, soft nap the operation will be without result.

However, with the last set of teasles, and when the close, soft nap has been secured, the operator can then gig with the luster for the object by the use of more water; a continued gigging in full water may, if necessary, be continued from fifteen to twenty runs. Immersing the gigged fabric, wrapped upon a roller, in clean, soft water for about twenty hours will help to impart a nice feel to the fabric thus treated. On the other hand, a longer immersion or the use of hard water for this purpose will not give such good results.

Gigging Heavy Fabrics

Some fabrics, more particularly the heavy weight, require gigging on the back as well as on the face of the cloth.

If dealing with a very heavy cloth it may be found advisable, after it has been gigged slightly both on its face and back, to steep it for three or four hours in water at a temperature of 145 deg. Fahr., then to rinse it with a little fuller's earth and continue the gigging process, dissolving and in turn removing in this manner any traces of dyestuffs and soap still remaining in the structure; this, as will be readily understood, will tend to soften the cloth. If necessary, the cloth, after gigging, may be immersed a second time in hot water, the trouble and loss of time being readily compensated by the softer handle imparted to the goods.

With reference to drying the scoured or gigged cloths, do not leave them lying in their wet state any longer than is absolutely necessary, especially when the water used in the washing is inclined to be hard; the soft feel of the cloth will then be preserved as much as possible. It is said that squeezed cloth becomes softer and takes more luster than when it is whizzed on a hydro-extractor previous to drying, because the squeezing more properly resembles a wet pressing.

Do not use a higher degree of heat at the dryer than is absolutely necessary, and see that there is a good ven-

tilation; in fact, imitate the old-time drying in the open air as much as possible to preserve the softness of the cloth. A drying machine, in which the cloth is dried by a supply of warm air from a separate heating boiler, is preferred by some manufacturers to dryers in which the chamber is heated by a system of coils, and where the cloth is passed close to the heated pipes.

Systems of Pressing

Turning to press and steam lustering of the cloth, there are two systems of pressing, viz.: the hydraulic press and the rotary press. Many manufacturers prefer the first for a soft handle on the cloth, claiming that although the action of the hydraulic press is more intense it leaves the cloth softer than the rotary press. This contention may be correct, taking into consideration that the moisture evaporating in consequence of the heat of the surfaces in the hydraulic press cannot escape as readily as on the rotary press, but remains in the cloth and consequently keep its soft.

However, the modern rotary presses, with their strong cylinders and large pressing surfaces, are really excellent machines for producing a soft handle to the cloth. In these modern presses the cloth remains a longer time under pressure than was the case with former makes, and for this reason and on account of their greater production they are universally adopted. In fact, no woolen or worsted finisher can afford to be without one of these modern rotary presses, although for steam lustering purposes the hydraulic press is unrivaled.

If the fabric has been pressed too much it is easily corrected by running it over the steam brush, when any unduly strong luster is partly dulled again, the process at the same time assisting in giving the fabric thus treated a soft feel.

Moist steam, as well as an excessively high pressure of steam, must be avoided in steam lustering, as wet steam makes the cloth hard and stiff. For this reason proper escapes for condensed steam must be introduced. A pressure of from one to one and one-half atmospheres is sufficient to obtain the best effects in steam lustering, and rather than attempt too much at once it is better to repeat the operation with a low steam pressure and smooth the face again after the shearings between these operations.

When making the cloth ready for the market, one or more passages through the steam brush, which must be very soft, are recommended. Use dry, steam and, finally, a double cold pressing on the hydraulic press, or a warm pressing on the rotary press. Cloth that is not to be steam-lustered may also receive a good warm pressing on the rotary press first, and then be steamed on the steam brush or upon a roller. In the latter case, in order to impart softness to the cloth the fabric should be loosely rolled and unrolled immediately after steaming, thus permitting the cloth to cool in a loose condition.—Wool Record and Textile World.

The Dyeing of Cotton Goods

By J. STEPHEN HEUTHWAITE

Fixing of Cotton Colors

As cotton has no chemical energy, it is difficult to fix any colors but those of the substantive class on the fiber. Leaving aside Aniline Black or the dyeing with metallic salts and several other specialties (Paranitraniline Red, etc.), there are two different groups of colors for cotton dyeing: (1) Mordant colors, and (2) direct-dyeing or substantive colors.

All basic colors, which are fixed with the aid of tannic acid, antimony, tin salts, etc., as well as mordant colors proper, which are fixed on the fiber with metallic salts, belong to the first group of colors. To this class belong, also, for instance, colors of the alizarine class, which are fixed on a chrome or alum mordant and which are extremely fast to light and washing—Turkey Red, Alizarine Blue, etc.—as well as a large number of natural dyestuffs, such as logwood, cutch, etc.

Indigo is a direct-dyeing color, and to this class of dyestuffs belongs also the most extensive group of artificial colors—viz., the substantive azo colors and the more recently discovered sulphide dyestuffs, which have so promising a future.

DYEING WITH SUBSTANTIVE COLORS

Preparing the Dye Bath

The principle of dyeing cotton with substantive colors consists in allowing the fiber to come into contact for a longer or shorter time with the cold or hot dyestuff solution, the fiber absorbing the color from the aqueous solution. The temperature of the dye bath, the duration of the impregnation and other essential points vary according to whether the goods are dyed in a machine or not, and also to the respective machine employed.

Dissolving of the Color

The substantive colors are not difficult to dissolve; it is best to stir up the color uniformly in a bucket, first made into a paste with boiling water and then the color completely dissolved by constant stirring. It is sometimes advisable to add a little soda to the hot water used for dissolving the dyestuff, especially in the case of hard water, as the harder the water the more difficult the color is to dissolve and the greater amount of soda required necessary to bring the dyestuff into solution. It is best to add the color solution to the dye bath through a sieve and to rinse the bucket with water until all the color is thoroughly dissolved.

Another method of dissolving that is used in many dyehouses is as follows: About one-quarter of the necessary amount of water required for dyeing is run into the dye bath or vat, and, according to the hardness of the water,

a greater or smaller amount of soda added. The bath is then boiled up and the dyestuff added, which is best done through a sieve under constant stirring, and then cold water run in to fill up. This process is very simple, and in most cases there is no risk in resorting to same; but one is never positively sure that every particle of color is properly in solution or has not become caked on the bottom or the sides of the vat. It is more advantageous in dyeing light and combination shades to previously dissolve the color separately.

With regard to the addition of soda to the dye bath, it is entirely wrong to add the color first and the soda afterward. In calcareous water carbonate of lime is precipitated in a fine form by the soda, which in subsiding attracts a great part of the color, in solution, in consequence of which a certain amount is rendered ineffective. This is prevented by reversing the process. In excessively calcareous water it is best to convince oneself that all the lime has been precipitated by the soda, which is done by adding a little soap after boiling up. If the lime has been precipitated the soap forms a lather, otherwise the insoluble lime soap.

As regards the dissolving of sulphide colors, which have generally to be dissolved with sulphide of soda, this will be dealt with later.

The Addition of Salt to the Dye Bath

The addition of salt to the dye bath has the effect of causing substantive colors to go onto the cotton fiber better.

These bodies, which are generally though incorrectly called mordants, partly diminish the solubility of the color in water and increase the affinity of the color to the fiber. The most commonly used "mordants" are common salt and Glauber salt; on the whole, both have an equal effect, and it is merely a question of price which of the two has to be employed. In Italy and other countries Glauber salt is considerably cheaper than common salt, the latter being liable to a heavy duty, whereas in other countries common salt proves to be the cheaper. Common salt has an equal effect in dyeing as the same amount of calcined Glauber salt. Common salt is generally used in the form of cheap horse, garden or rock salt; the impurities in the salt are often without any disadvantages, but on the whole it is better to use Glauber salt, as impure common salt often contains considerable quantities of lime and magnesia salts. Glauber salt is sold in the form either of crystals or of calcined anhydrous salt:

1 pound of calcined Glauber salt = 2 pounds 3 ounces Glauber salt.
1 pound of Glauber salt crystals = 7½ ounces calcined crystals Glauber salt.

Soda has just the contrary effects to these salts; as mentioned above, soda, when added in not too large quantities, increases the solubility and prevents the color from rushing into the fiber too rapidly. The less soluble the color is and the quicker it goes into the fiber the greater is the amount of soda required to keep it in solution and produce level shades. Colors which do not easily level are best dyed with merely the addition of soda without any other ingredient. Only when used in excessive quantities—say, about 10 per cent—has soda the effect of salting out. The percentage of soda given in the following refers to soda ash (calcined soda):

1 pound soda ash ½ 2 pounds 11 ounces soda crystals.
1 pound of soda crystals = 6 ounces soda ash.

Soap has a similar effect to soda—i. e., it improves the solubility and the level-dyeing property of the color. The employment of soap in the dyehouse has considerably decreased in recent years, as the cheaper soda has in nearly all cases the same effect.

For practical purposes the following components hold good. The most common additions to the dye bath for almost any color consist of a combination of Glauber salt (or common salt) and soda, the latter being added to the bath just before adding the color.

In dyeing light shades, Glauber salt (or common salt) should not be added until part of the color has already been fixed on the fiber. As a rule, for light shades the addition is about 5 per cent Glauber salt and 2 to 3 per cent soda ash; for dark shades, such as browns, blacks, etc., 20 to 40 per cent Glauber salt and 3 to 5 per cent soda. If the bath has to be exhausted as much as possible, when the dyeing process has been carried out halfway the same amount of salt should be added. In dyeing colors which are susceptible to acids, such as Congo Red, Benzopurpurine, etc., in many cases only soda is used in dyeing, and the goods should either not be rinsed afterward or be passed through a rinsing bath containing soda. In this manner the susceptibility to acids is partly decreased.

For bright shades, especially yellows, sodium phosphate is employed. This improves the clearness in shade, but otherwise has the same effect as a combination of Glauber salt and soda, and is applied in exactly the same way. The usual combination is 20 per cent phosphate of soda and 2 to 5 per cent soap.

Volume of Liquor

As the substantive colors, with the exception of light shades, are never exhausted, but part of the dyestuff remains in the dye bath, it is natural that the longer the liquor is for the quantity of goods to be dyed the more color remains in the dye bath. Although this color is not wasted, as it is possible to dye again in a standing bath, it is, however, desirable in most cases that the baths should be exhausted as much as possible. This can be attained by dyeing in as short a volume of liquor as possible. The volume of dye liquor corresponds to the

amount of goods to be dyed; as expressed, for instance: 15:1 of goods—i. e., 15 pounds of water to 1 pound of material. Thus, if 25 pounds of water are to be used for 1 pound of goods, this is expressed as 25:1 of goods.

The volume of the dye liquor is of great importance as regards the depth and evenness of shade. A different shade is naturally obtained when dyeing in a short or long liquor. When working in a short liquor with the same amount of color, deeper shades are obtained and the bath is better exhausted. Of course, the short volume of liquor has to be kept within certain limits, as otherwise the color would dye unlevel or precipitate, for which reason light shades are dyed to advantage in a long liquor.

No hard-and-fast rule can be given as to the volume of the dye liquor. When dyeing in apparatus—above all, in the jigger—very often unusually short liquors are employed (frequently, for instance, 1:1); whereas, when dyeing light fashionable shades on mercerized goods, a very long liquor is employed. The normal volume of the dye liquor can be fixed at 15 to 20:1, which would correspond to 75 to 100 gallons of water for 100 pounds of goods.

When dyeing in machines, the volume of liquor can vary to only a slight extent, and such variation depends upon the quantity of material and dyestuff employed.

Dyeing Process

Apart from the previous boiling out of the yarn and pieces, which is done in many dyehouses, the goods in most cases do not require any further treatment before dyeing. The goods are, as a rule, entered dry; but especially in the case of very dirty loose cotton, which may have previously been used for cleaning machines, the material is scoured before dyeing in a bath containing soda, and the oil which then floats on the top of the liquor is skimmed off, as otherwise it would have a bad effect on the color.

For very light and clear shades the cotton has to be previously bleached, which is almost exclusively done with chloride of lime (bleaching powder, chemicking). In the process great care has always to be taken, and oxycellulose is formed by too strong oxidation. In dyeing dark shades, bleaching is not necessary.

Dyestuffs fast to chlorine can be added direct to the bleaching bath. For instance, pale yellow and creams are produced by adding Chloramine Yellow to the bleaching bath, whereby one process is saved. To increase the affinity of the cotton for the dyestuff, it is advisable in isolated cases to previously treat the cotton with caustic soda. It is a well-known fact that mercerized cotton more easily absorbs substantive colors; it has lately been proved that very diluted caustic soda, such as employed for bleaching, considerably increases the affinity of the fiber for the dyestuff without contracting the cotton fiber to any extent.

In order to cause the cotton to become more readily impregnated with liquor in the dye bath, it is advisable in many cases to add some Turkey red oil to the dye bath. The addition has also the advantage that it causes the color to more easily dye level, and is employed to advantage in dyeing in cases where difficulty arises in getting level shades—for instance, in dyeing light shades, especially on mercerized yarn. In dyeing pieces it is best to employ soap for this purpose.

Temperature of the Dye Bath

It can be taken as a general rule that the temperature of the dye bath should be 85 to 105 deg. Fahr. for light shades and 175 to 212 deg. Fahr. for dark shades on entering the goods. Very light shades are dyed best in a merely lukewarm bath. For dark shades the bath is generally brought up to the boil; it is, however, in most cases more advantageous to shut off steam and continue dyeing in the liquor as it is cooling down for another half to one hour, as thus the shades become considerably darker. It is not advisable to allow the goods to remain in the bath overnight, as the bath either decomposes or the color precipitates.

As the admission of direct steam considerably dilutes the dye bath, thus preventing the color from falling on so well, it is better, as a rule, to work with indirect steam, which, in consequence of the evaporating of the dye liquor, causes the latter to gradually become more concentrated. For such special case, where for some reason it is necessary to dye at a low temperature, such colors should be selected as dye best in a lukewarm bath. For some unaccountable reason, the trials made in bulk to dye cotton cold have not led to the general adoption of this process; probably the duration of the dyeing process is too lengthy.

As soon as one batch has been dyed the next batch is added, as a rule, without considering the temperature of the dye bath.

Duration of Dyeing

As a rule, dyeing takes place for one hour at 212 to 180 deg. Fahr., in which time the maximum of color is exhausted. Working in the cooling-down bath has already been referred to. When working certain machines, such as warp dyeing, etc., it is often desirable to dye in as short a time as possible. In such cases, colors should be preferably chosen which yield good results according to the shortest dyeing method—i. e., those which exhaust quickly.

Dyeing in Standing Baths

As already mentioned, when dealing with the dyeing of substantive cotton colors the baths are very seldom exhausted; in light shades the quantity of the color remaining in the bath is often only a fractional part of 1 per cent; so that, as a rule, it is not worth while preserving the baths; but in dyeing dark shades, although various

colors behave differently in this respect, one-third to one-quarter of the quantity of color originally taken remains in the bath, according to the volume of the dye liquor used.

For this reason the baths should be preserved and employed for subsequent lots—i. e., dyeing in "standing baths." If the goods to be dyed are clean, such as is generally the case with yarn and piece goods, the baths can be preserved for weeks, and often for months. In dyeing loose cotton that is very dirty, it is not recommendable to keep the baths for a long time, as the quantity of impurities thus obtained in the dye bath often causes more color to decompose than is actually saved. Therefore, when dyeing such class of goods the bath should be prepared fresh each day, and at the least each week.

In dyeing in standing baths, the quantity of salt need only be one-fourth to one-fifth of the quantity necessary in preparing for first bath, and the quantity of color requisite depends upon the amount of color exhausted in the previous bath; experience soon shows the exact quantity necessary. If in one or other of the instances the precipitating color should cause the bath to become muddy they must be boiled up well and the quantity of salt considerably reduced, or even left out altogether; if the bath does not become clear on boiling up, the liquor should be run off and a fresh bath prepared, with due care in adding the right quantities of salt. Standing baths should, when tested at 60 deg. Fahr. with the hydrometer, not be more than 6 to 7 deg. Tw. for medium shades and for light shades should be still less.

Rinsing

After dyeing, the goods should be rinsed in cold water until no more color comes off. For light combination shades on yarn it is often advantageous to add a little common salt to the rinsing bath. This is particularly advantageous when fancy shades have been dyed with a combination of colors which are not alike in solubility. It often happens that such shades on coming out of the dye bath appear perfectly dyed, but when dried are quite uneven. The reason of this is that when the water contained in the goods after rinsing becomes warmed up in drying, a part of the easily soluble dyestuff is dissolved, and at the bottom of goods hung up to dry the water accumulates and evaporates, thus causing the bottom part of the goods to be dyed a darker shade than the rest. As the solubility of a color in salt water is considerably less than in ordinary clean water, such unevenness in shades does not appear to such a great extent if the last rinsing bath contains salt.

Drying

Drying is done either in a drying chamber or in drying stoves which can be warmed up 100 to 120 deg. Fahr., with a good ventilation, or it can be done on special machines, such as, for instance, drying piece goods on the dry cans. These are often covered up with linen in order to prevent the goods from coming into contact with the metal parts of the cans. As heat has the effect on many colors of altering the shade, and the original tone only returns slowly on cooling down in the air, it is advantageous when drying in such a manner to employ such colors as are fast to ironing.—The Textile Manufacturer.

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